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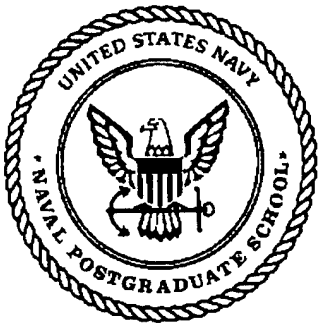

THESIS

ANALYSIS OF U. S. NAVY MEDICAL SERVICE CORPS HEALTH CARE ADMINISTRATOR DIRECT AND INSERVICE PROCUREMENT ACCESSION PROGRAMS

by

DeAnn J. Farr

December, 1994

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This thesis uses bivariate and multivariate analysis to estimate the factors that influence the effectiveness of U. S. Navy Medical Service Corps (MSC), Health Care Administrator (HCA) Inservice Procurement Program (IPP) and the Direct Procurement (DP) officer accession program. Using data from the Navy Officer Master File, the Navy Officer Loss File, and the Navy Personnel Research and Development Center's Officer Fitness Report File, comparisons are made of the officers accessed though DP and IPP. Ordinary least square models estimate the influence of procurement source, education, and personal demographics on separation behavior and fitness report ratings. Proportional hazard models estimate the years of commissioned service MSC HCA officers are expected to complete before retiring or being voluntarily released from active duty. Logit models evaluate the probability of being promoted and the probability of having an above-average fitness report performance score as a function of procurement source, education level, college quality, and personal demographics. The findings reveal that MSC HCAs with ten or more years of commissioned service tend to leave within a few years of becoming eligible to retire. Differences in educational levels and early performance between officers accessed through IPP and DP were noted. Based upon research results, it is recommended that a benefit-cost analysis be conducted to determine the optimal MSC HCA accession policy.

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by

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ABSTRACT

This thesis uses bivariate and multivariate analysis to estimate the factors that influence the effectiveness of U. S. Navy Medical Service Corps (MSC), Health Care Administrator (HCA) Inservice Procurement (IPP) and Direct Procurement (DP) Officer accession programs. Using data from the Navy Officer Master File, Navy Officer Loss File, and Navy Personnel Research and Development Center's Officer Fitness Report File, comparisons of the officers accessed though the DP and IPP are presented. Ordinary least square models estimate the influence of procurement source, education, and personnel demographics on separation behavior and fitness report performance. Proportional hazard models estimate the years of commissioned service MSC HCA officers are expected to serve before retiring or being voluntarily released from active duty. Logit models evaluate the probability of being promoted and the probability of having above average fitness report performance values as a function of procurement source, education level college quality, and personal demographics. The findings reveal that MSC HCAs with ten or more years of commissioned service tend to leave within a few years of becoming eligible to retire. Differences in educational levels and early fitness report performance between officers accessed through IPP and DP were noted. Based upon research results, it is recommended that a benefit-cost analysis be done to determine the optimal MSC HCA accession policy.

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I. INTRODUCTION

A. BACKGROUND

Faced with budget cuts, infra-structure reductions, and a redefined mission, the United States Navy is challenged with "right-sizing" the fleet under some of the most dynamic conditions in its history. Although Navy Medicine has been spared drastic force reductions, as end-strength numbers are reduced, manpower analysts must develop plans and policies to pattern present and future force structures.

In conjunction with the constraints cited above, one cannot ignore changes imposed by military medicine's transition toward increased operational "jointness" in the manpower planning process. Consolidation of selected health care resources under the auspices of the Assistant Secretary of Defense for Health Affairs (ASD/HA) and intensified resource sharing between the military and civilian sectors, combined with the complexity of health care management, present the armed forces with the challenge of planning manpower structures to meet projected requirements in a continually changing environment. These influences amplify the need to recruit highly-qualified professionals who are willing to make a long-term commitment to the organization. As medical systems become more complex, a stable and experienced force structure of health care executives within the Medical Service Corps (MSC) becomes increasingly essential to mission accomplishment. In this endeavor, every effort must be made to ensure that only the best-qualified people are selected and retained.

Following the inception of the MSC in August 1947, the Inservice Procurement Program (IPP) was established as a tool to obtain the authorized number of MSC officers and reduce their transition time into Navy Medicine. At that time, MSCs were primarily medical supply and administration officers and were compared to Limited Duty Officers, as evidenced by their pay grade and duty restrictions. This is no longer the case. The

Medical Service Corps is a diverse and well-educated group of health care specialists. It has been remarkably successful in establishing itself as a community of professional Naval officers.

The Navy MSC has approximately 2,800 officers on active duty in the grades of Ensign though Rear Admiral (Lower Half). About half of the MSCs are Health Care Administrators (HCAs), with eleven different sub-specialties. The other half of the corps consists of Health Care Science (HCS) specialists in twenty-two subspecialties. Over 65 percent of the HCAs have had more than four years of enlisted service before commissioning.

Entry into the MSC HCA community is accomplished by either one of two routes: direct procurement (DP) through the Navy Recruiting Command (NRC) or the enlisted commissioning IPP. The IPP restricts the pool of applicants to Navy active duty Hospital Corpsmen and Dental Technicians in pay grades E-5 and above and does not require successful completion of a baccalaureate degree to qualify for selection. However, an applicant must complete a bachelor's degree prior to receiving their commission and within two years of selection. The bachelor's degree may be accomplished through fully-funded education. Prior to 1987, the IPP did not require a bachelor's degree. The IPP selection board meets once a year and consists of senior MSC officers from various commands, backgrounds, and levels of expertise with selection boards. The IPP board must make its selections from the applicants presented to the board. Education and training costs for IPP include the Officer Indoctrination School (OIS) and, potentially, two years of fully-funded undergraduate education. OIS is a six-week course of instruction designed to assist newly-commissioned staff corps officers with their transition into the role of a Naval officer. Entry through IPP has been limited to no more than 25 percent of total MSC HCA accessions; but, beginning in fiscal 1995, up to 50 percent of total accessions may be obtained through IPP.

Another policy change affecting the IPP program is the National Defense Authorization Act, enacted in December 1991. Under this provision, beginning fiscal 1996, all officers will be initially appointed as reserve officers. This requirement means that all officers, regardless of commissioning source will compete on equal terms for appointments as regular officers. Prior to this legislation, IPP accessions were automatically granted commissions in the regular Navy. The MSC will initiate this policy beginning in fiscal 1995.

Direct procurement (DP) provides the MSC administrative specialist community with a large pool of well-qualified applicants from both the military and civilian sectors, including many prior-enlisted personnel. Applications are reviewed for technical and legal qualifications by NRC, then forwarded to the Bureau of Medicine and Surgery (BUMED) for screening of professional qualifications and general desirability. The BUMED Professional Review Board (PRB) meets quarterly and consists of senior MSC officers from the Washington, D.C. area. Professional standards and PRB members do not vary much over time. The PRB may decide not to select any of the applicants presented and may withhold its selections until additional applications are received for review at the next board. This process only mandates that accession quotas are met before the end of the fiscal year and allows the PRB to select only the most qualified applicants. Once quotas are met, applications for highly-qualified people may be held until the next fiscal year, when new quotas become available.

Direct procurement applicants must have a baccalaureate or a master's degree from a college or university accredited by a regional accrediting agency. Baccalaureate graduates must have a major in one of the following areas: Health Care Administration, Health Services Management, Health Policy, Business/ Management, Human Resources Management, Financial Management, Accounting, Public Administration, or Management of Technology and Information Systems. Applicants at the master's level must have a professional degree in health services management, business management or policy, or

a graduate degree with a major field of concentration in health services management (Bureau of Naval Personnel, 1993). The primary training cost associated with this accession path is for OIS.

The Navy is the only service that has an enlisted commissioning route for MSCs. The Army and Air Force obtain their MSCs from the Reserve Officer Training Corps (ROTC) program, Officer Candidate School (OCS), transfers from the line communities, and their respective military academies. The Air Force recruits over 50 percent of its MSCs from civilian (direct procurement) sources, which include enlisted personnel who have earned a degree through off-duty education. The Air Force's direct procurement program accounts for no more than 10 percent of its accessions. The Air Force requires a minimum of a master's degree for all MSC HCA accessions obtained through direct procurement, except for enlisted personnel, who must have a bachelor's degree, combined with exceptional performance and experience in the health care field. The Army does not obtain MSC HCAs from direct recruitment sources. Its accessions are not designated as MSCs before completing ROTC or OCS. Assignment to the Amy MSC is based upon openings in the various related specialties. The Army requires only a bachelor's degree for new MSC accessions; however, they must complete an internship and master's degree through the Army's Baylor University program after assignment to an MSC administrative military occupational specialty (MOS).

The Center for Naval Analyses (CNA) conducted a study of MSC accession and retention in 1989 and found that "the [Navy] MSC is a healthy community with only a few of the Health Care Science (HCS) specialties experiencing accession or retention problems" (Dolfini 1989). In fact, CNA found that "overshipping" of MSC administrative specialty accession quotas was common due to the inability of other medical communities to meet their accession goals.

After evaluating retention issues, the 1989 CNA study determined that there was a significant difference in the "stay or leave" decision points in the career paths of MSC officers. The following findings were provided:

> At the three-year point, the Health Care Science (HCS) continuation rate drops to 79 percent, while the HCA continuation rate decreases slightly to 93 percent. This drop in continuation rates corresponds to the end of the initial obligation. HCA officers have somewhat higher continuation rates from 4-10 years because HCA officers with previous enlisted experience need only 10 years of service to reach retirement eligibility. Yet, the aggregate continuation and retention figures provide only an overview of the MSC; they do not discern information regarding losses in terms of career path progression and in terms of experience and skill mix. It is possible that retention problems do exist within specific specialties and among individuals with certain experience levels (Dolfini 1989).

Since IPP accessions usually have at least ten years of enlisted service before commissioning, it is likely that few of these accessions stay in the military for more than ten years of commissioned service, when they become eligible for retirement. Understanding the significance of this trend is pivotal in force management. The potential impact on the "normal aging" process of the force could create an unbalanced inventory with respect to experience, pay grade, and skills, which, in turn, would cause promotion stagnation and higher personnel costs. In addition, insufficient numbers of senior HCAs may result in assigning HCS officers to executive medicine positions as "outfills." Although this provides HCS officers with the ability to develop as health care executives, it reduces the availability of direct health care providers, resulting in shortfalls within their respective communities.

B. OBJECTIVES

For medical department managers to meet the challenges of force "right-sizing," their accession plans must anticipate requirements for professional development (training and education), career progression (promotion), and job security (augmentation) so that the very best of those recruited can be retained. This thesis focuses on one element of community management: accession policies and their impact on MSC total force

management. Some issues to be considered when evaluating accession programs include monetary and human capital costs, differences in officer retention, projected size and desired composition of the force, special contributions of the accession source, and measures of officer effectiveness or productivity. In essence, the success of a commissioning source may be evaluated by answering two fundamental questions that are addressed in this thesis. First, does the source ensure that qualified and productive professionals are selected? Second, does it produce a career officer?

The first question may be answered by creating a performance index for each individual (using fitness report data) and evaluating the relative effect of the accession program on performance (using multivariate analytical procedures). The second question may be addressed by comparing accession source with years of commissioned service. Variables that have an influence on years of commissioned service before leaving the Navy may be determined using multivariate techniques.

Accession sources must maximize resources and enhance the image of professionalism while ensuring that only the best-qualified applicants are selected for commissioning into the Medical Service Corps. With a smaller, smarter, and more specialized military, Navy Medicine must recruit and retain only the best people, as it continues to recognize the dynamic changes and high standards within the health care industry. This thesis attempts to provide information that will aid Navy Medical Department planners in developing effective accession policies. Fundamentally, this thesis evaluates if the IPP and DP accession paths provide high-quality, career officers who may offer the visionary leadership essential to guide Navy Medicine into the future.

The Defense Officer Personnel Management Act (DOPMA) requires that officers be commissioned prior to their 35th birthday to ensure that they can complete twenty years of commissioned service before reaching the age of 55. This is a requirement regardless of prior enlisted service. Using the DOPMA benchmark, a "career officer" is defined as one who completes at least twenty years of commissioned service. "High-

quality officers" are distinguished in this study by observed performance measures, college quality, and level of education. Development of these measures and indices is discussed in Chapter III.

C. SCOPE, LIMITATIONS, AND ASSUMPTIONS

The Navy MSC HCA specialists' sub-community is the subject of this thesis. The diversity and complexity of the HCS sub-community complicates analysis of this group as a whole and requires evaluation of each individual sub-specialty. Although HCAs are divided into specialties, they have several common elements, which helps to simplify analysis. This group is divided into the sub-categories defined by their accession path (DP or IPP) for comparison purposes. This thesis compares and evaluates strengths and weaknesses of the DP and IPP programs in terms of their ability to provide productive, career officers.

Retention is one measurement of accession program effectiveness. Historical loss data are used to derive proportional "hazard" rates to establish a distribution of separations based on years of commissioned service. Hazard rates are also referred to as "failure rates," indicating that someone has "failed or left the system." Some researchers prefer to view these measures in positive terms as "survival rates," for those who survive or stay in the system. Regardless of the terminology, the procedure to obtain these rates employs a multivariate proportional hazards general linear model. For consistency, this study uses the term "hazard" rates.

Since officers with at least ten years of prior enlisted service usually retire, rather than separate without retirement, evaluating successful completion as a career officer based upon retirement alone may not be a valid measurement. As previously discussed, the target population for IPP accessions is enlisted medical department personnel with at least four years of service. Accordingly, survival rates can be used to forecast years of

commissioned service for officers who entered the MSC through one of the two accession paths. Techniques to estimate retention as a function of years of prior service are discussed in Chapter III of this thesis.

Officer performance is another important measure of accession program effectiveness. Officer fitness report data, provided by the Navy Personnel Research and Development Center, San Diego, CA are used to evaluate officer effectiveness. Use of these data is a potentially limiting factor for this thesis, as it assumes that officer fitness reports are fair and accurate measures of performance. Since these reports are frequently subjective and open to criticism about so-called "inflation factors," they may present an incomplete depiction of actual performance.

Finally, the officer's education level, college major, and college quality provide another perspective on officer quality. Although unavailable, work experience prior to commissioning and affiliation with professional organizations would give a more complete picture of the officer's abilities. The Navy MSC is developing an additional qualification designator (AQD) to identify officers who have obtained "Diplomate" status in the American College of Health Care Executives (ACHE). This policy was developed to gauge professional development and to identify personnel who may qualify for executive medicine positions. Unfortunately, data are not yet available for this variable.

A final limitation in this study is the quality of the available data. There are significant shortfalls in historical information regarding personnel losses to the system. Loss data provided by the Defense Manpower Data Center had several coding errors prior to 1987. Officer accession codes in the loss file are unreliable. For example, officers accessed through the IPP have data source codes that are either "Direct Accession: Non-professional," "other miscellaneous," or "unknown" programs. As a result of these inconsistencies and the lack of a specific code that identifies an accession as an IPP, it is not possible to separate losses by accession source. However, distinctions are made based upon years of enlisted service to act as a proxy for accession source.

D. ORGANIZATION OF THE STUDY

This study is organized into five chapters. Chapter II reviews the pertinent studies and literature. Chapter III describes the various data files used in the study. A detailed explanation of the research methodologies utilized for the models is also provided. Chapter IV presents the results of the study. Chapter V summarizes the results and presents conclusions based upon the statistical analysis. Additionally, general recommendations derived from this research effort are presented in the concluding chapter.

II. LITERATURE REVIEW

A. GENERAL INFORMATION

Previous research on officer accession programs and productivity measurement has been limited. Analytical studies in this area for the Medical Service Corps (MSC) are virtually non-existent. Apparently, the only Navy MSC-specific study on retention or accession source was done in 1989 by the Center for Naval Analyses (CNA). This was a research memorandum on MSC accessions and retention, but did not evaluate policies or address officer performance. (Dolfini, 1989)

The most significant contribution provided by previous studies is the development of methodologies for evaluating an officer's effectiveness. Previous studies typically use three factors or indicators to measures an officer's success. These indicators are performance (as measured by fitness reports), promotability (displayed by promotion to the next pay grade), and retention beyond the period of initial obligation. Many studies of Naval officer performance using fitness report data have been conducted by the Navy Personnel Research and Development Center (NPRDC).

Despite the perceived problem of "grade inflation" in fitness reports (FITREPs), they are widely used to screen officers for fully-funded graduate education programs, job assignments, and selection boards (promotion, redesignation, etc.). Commanding officers use the FITREP to identify and reward top performers and state that it is completed to "get . . . people promoted and, where relevant, into command positions within their specialty." (Bjerke et al., 1987) Additionally, detailers report that by using FITREPs "it is easy to identify the top and bottom promotion candidates, but difficult to distinguish among the middle crunch." (Bjerke et al., 1987) Finally, FITREPs have published and quantifiable standards for awarding evaluation marks; they provide a cumulative record

of performance; and they provide observations at different career points and positions and with different reporting seniors. For these reasons, FITREPs are generally regarded as acceptable measures of performance, with adequate variation for analysis.

Accession policy research typically compares the U. S. Naval Academy (USNA), Officer Candidate School (OCS), and the Naval Reserve Officer Training Corps (NROTC) in terms of their cost-effectiveness and ability to provide "productive," career-oriented officers in the line communities. However, USNA and NROTC are education and training programs, aimed at the end result of commissioning. On the other hand, OCS is solely a commissioning program in that it does not provide education, just a method of screening officer candidates who completed undergraduate education prior to entering the system. The value of comparing these three "accession" programs is important primarily from the perspective of establishing statistically practical methodologies.

Most prior studies exclude officers accessed through enlisted commissioning programs, since they are considered just a "small percentage of officers." (Nolan, 1992) None of the studies reviewed for this thesis considered whether officers with prior enlisted service were excluded, regardless of accession source. However, the literature reviewed contained relevant methodology for developing "models of effectiveness" using performance criteria and retention as measures. Although the objectives of previous studies are different from those presented here, they provide reasonable reference points for developing a methodology.

B. ACCESSION AND RETENTION

In a study conducted at the Army's Academy of Health Sciences, Fort Sam Houston, Texas, Captain Michael Ciccocioppo (MSC, USAF) reported that "the Air Force is experiencing a shortage of upper grade Medical Service Corps officers because of past emphasis on the selection of prior enlisted members for commission in the corps."

(Ciccocioppo, 1983) Since prior-service officers had between one and sixteen years of time as an enlistee, many retired upon completing ten years of active commissioned service. This, coupled with the "glut of civilians graduating from Master's programs in health administration, prompted the Air Force to shift its emphasis from obtaining officers from enlisted ranks to obtaining them from civilian sources." (Ciccocioppo, 1983)

Ciccocioppo focused on a job satisfaction survey of Air Force MSCs and found that civilian accessions were satisfied in their jobs and "that the retention rate of this group should be good." (Ciccocioppo, 1983) He further recommended that the Air Force continue to recruit new MSC officers from outside the military.

Prior to the Ciccocioppo study, Colonel Donald Wagner, Chief of the Air Force Medical Service Corps, stated: "We need to commission more civilians with health care experience, either with or without the Master in Health Administration (MHA) to become MSCs." (Boone, 1980) He went on to discuss achievement of a "better mix of new MSCs from both civilian and military backgrounds."

In response to congressional concern regarding the accession and retention of military health care professionals, Michelle Dolfini from CNA studied MSC accession and retention rates from fiscal 1983 through fiscal 1988. Dolfini's goal was to detect if a manpower shortage existed in the MSC. Regarding retention, this study offered the following findings:

> HCA officers tend to stay in the Navy during their first 10 years of commissioned service as compared with the continuation rates of the HCS community. Once they reach 10 years of commissioned service, HCS officers tend to make a long-term commitment to the Navy, resulting in high continuation rates until 20 years of service (their typical retirement eligibility point). In contrast, the continuation rates of HCA officers decline after 10 years. These different continuation patterns between HCA and HCS officers are largely a function of the fact that most HCA officer have enlisted experience and thus are eligible to retire before 20 years commissioned service. (Dolfini, 1989)

In general, Dolfini found that the MSC was a healthy community with only a few HCS specialties (pharmacists, clinical psychologist, and optometrists) experiencing accession or retention problems. Dolfini recommended that health professional scholarship programs be initiated for these specialties. Additionally, she recommended that the practice of "outfilling" HCS clinicians and allied scientists into executive medicine billets be discontinued. (Dolfini, 1989)

Outfills are MSC billets in which an HCS officer is functioning in an administrative position that is not considered a 2XXX (executive medicine) billet. The HCS community believes that this practice allows its specialists to obtain valuable experience necessary for promotion. However, many of these officers continue to "serve in HCA billets while retaining their clinical or allied science specialty designation." (Dolfini, 1989) Even though these HCS officers are not working within their specialty, they are counted against their specialty end- strength numbers, resulting in an "inaccurate account of available manpower resources" for each community. Dolfini expressed the concern that this practice results in a diminished support staff that could "mean additional work for physicians or additional cases sent out on CHAMPUS." (Dolfini, 1989) Whether adequate numbers of qualified senior HCAs were available to fill these billets, if the outfill assignment policy were to be altered to exclude HCS officers, was not addressed.

Despite Dolfini's concerns, the practice of outfilling has some distinct benefits for Navy Medicine. First, not only does it provide the Navy with a balanced perspective within executive medicine positions, it yields valuable experience tours for HCS officers. Second, this policy enhances cohesiveness within the MSC. Third, outfilling enables Navy Medicine to retain a very experienced group of health care professionals who may need a "change of pace" that otherwise may only be obtained in the civilian sector. Finally, it opens the pool of potential health care executives so that only the best officers are selected to fill these key positions.

C. OFFICER PERFORMANCE INDICES

Initial research developing officer performance indices focused on USNA and attempted to establish statistical relationships between USNA selection criteria, academic performance, and subsequent performance as an officer in the fleet. In a 1989 study, "Development and Evaluation of an Officer Potential Composite," researchers at NPRDC assessed USNA's candidate selection system. Idell Neumann and her associates set out to "expand the scope of the USNA selection system to include prediction of officer performance." In this endeavor, the researchers developed an officer performance criterion incorporating individual fitness report data. This was used to evaluate USNA's success in providing the Navy with successful officers. (Neumann et al., 1989)

Background information was obtained from USNA and combined with fitness report data for officers who graduated between 1979 and 1982. Fitness report data consisted of all fields on a FITREP, except narrative comments. Officers used in the study had completed at least four years of commissioned service and were sub-divided into four-year groups, warfare specialty, and pay grade. Fitness reports included in this summary had to be based on ensign (0-1), lieutenant junior grade (0-2), or lieutenant (0-3) performance and based upon the reporting senior's "close observation." Also, the reporting senior had to be simultaneously reporting on other officers within the command, so the only "occasions" of the FITREPs included were "periodic" or "detachment of reporting senior." This process eliminated a small number of reports that may have otherwise skewed the data. (Neumann et al., 1989)

Summary scores across an officer's fitness report history were then computed for three FITREP elements (command desirability, mission contribution, and recommendation for promotion). These scores displayed the proportion of occasions on which the officer received the highest possible rating. A score of 1.00 indicated that the officer received the highest rating in that element in all qualified fitness reports, and a score of 0.00 indicted that the officer had never received a top rating in that element. Analysis of the

summary scores revealed that many aspects of FITREPs, among this group of officers, were skewed to the upper end of the spectrum. For example, 61 percent of all officers received a top score in "mission contribution" and 58 percent received top marks in "command desirability." The exception to this trend was the "recommendation for promotion" field, with only 26 percent of the sample receiving top marks or recommendations for early promotion. This was then perceived to have the "greatest potential of all measures for use as a performance criterion." (Neumann et al., 1989)

As expected, differences in the mean criterion scores were found among the different grades, communities, and year groups. For example, scores became higher as the officer became more senior. To control for this variation, the data were standardized (using a mean of 50 and a standard deviation of 10). The standardized scores were then weighted by the number of fitness reports received by the individual in each grade during the selected study period. These scores were summed to obtain one score that represented the officer's composite fitness report history. (Neumann et al., 1989)

Neumann and her associates concluded that, although much prior research found that officer fitness reports "did not provide adequate discrimination for analysis, there was sufficient variability in early promotion recommendations to provide meaningful differentiation among officers." However, it was concluded that USNA's selection measures were not related to officer performance. (Neumann et al., 1989)

This study also recommended that officer performance measures displayed in the early promotion recommendations be explored by examining their relationship to actual promotion and promotion rates. Finally, the researchers recommended that the relationship between retention and the promotion recommendation criterion be explored. (Neumann et al., 1989)

In a subsequent study of USNA male graduates, William Bowman attempted to evaluate the theory that the "best" officers (of those who graduate from USNA) have technical degrees. This study, entitled "Do Engineers Make Better Naval Officers?," looked at two measures of junior officer fleet experience. The first measure used a

"snapshot" of officer performance at the end of an officer's fourth year in the fleet, based upon a periodic or annual FITREP. Bowman asserted that an officer should be judged as "superior" if he was recommended for early promotion and ranked in the top 1 percent category for both "command desirability" and for the "overall" summary in that single FITREP. Besides these criteria, he looked at retention (at least six months beyond initial obligation) as another measure. (Bowman, 1990)

Bowman's study found a very weak statistical relationship between under-graduate major and performance. However, he did find that staying six months beyond the initial obligation period increased the probability of being a superior performer by over 10 percent in the nuclear community and 6 percent in the surface warfare community (Bowman, 1990). Although there is *a'priori* knowledge to suggest that a relationship between retention and performance exists, it is beneficial to statistically validate this hypothesis.

Michael Foster's Naval Postgraduate School (NPS) thesis, "An Analysis of the Relative Productivity of Officers from Different Accession Sources," analyzed relative productivity of officers from the USNA, NROTC, and OCS accession sources. This study examined a sample of surface warfare and submarine officers, using NPRDC's fitness report data merged with information from the Defense Manpower Data Center (DMDC) Navy Officer Master File and the Navy Officer Loss File. Performance indices were developed using the two methodologies employed by Neumann et al. and Bowman. Applying multivariate techniques, his objective was to evaluate the effect of commissioning source on performance. The results of Foster's study showed that USNA graduates performed better than NROTC and OCS accessions, when measured by Foster's performance index. Additionally, he found that retention was not directly related to performance, but that having officers serve significantly longer than their original obligated service provides the Navy with an added return on its investment. (Foster, 1990)

Another NPS thesis considered models of effectiveness to evaluate accession programs. Joseph Nolan's thesis, "An Analysis of Surface Warfare Officer Measures of Effectiveness as Related to Commissioning Source, Undergraduate Education, and Navy Training," developed multivariate models to approximate the determinants of three measures of effectiveness (MOEs): retention, promotion, and early professional qualification. He specifically addressed performance differences by commissioning source and quality of graduate education. (Nolan, 1993)

Nolan obtained training data from NPRDC's TRAINTRACK System Files, which he merged with Naval Officer Promotion History Data File, derived from the Navy Officer Master Files and Navy Officer Loss Files. His data were restricted to Surface Warfare Officers (SWOs) reviewed by the lieutenant commander (LCDR) promotion board and accessed through USNA, NROTC, or OCS.

Nolan's statistical models used maximum likelihood estimation techniques. Explanatory variables included the following: personal demographics (gender, race, dependents, age at time of commissioning, prior enlisted service, and accession source); undergraduate education (major, grade point average [GPA], college quality, and academic profile code); Navy experience (service schools, billets, duty stations); and Navy training (academic setback, functional training, and skill progression training). College quality rankings were obtained from Barron's Profile of American Colleges, which uses five criteria to establish a selectivity scale from one to five. All variables were available from the merged data files. (Nolan, 1993)

The promotion model found statistically positive effects on promotion to LCDR for early professional qualifications, high GPA, attending department head school, and serving as a department head. Significant negative effects were obtained for being single, age at commissioning, and being male. Despite the multivariate findings, the bivariate analysis showed that OCS commissioned officers from high-quality undergraduate schools had promotion rates that were 6 percent and 12 percent higher than medium-quality and low-quality colleges, respectively. (Nolan, 1993)

In the early professional qualification model, negative effects were found for being single, age at commissioning, and being a minority. Additionally, he found that OCS and NROTC accessions were less likely than USNA accessions to achieve early professional qualifications. (Nolan, 1993)

Retention was defined as whether an officer had remained on active duty up to the LCDR selection board. In the retention model, the only variable with a significant positive effect was age at commissioning. However, significant negative effects were found for being Caucasian, receiving a commission through OCS or NROTC, attending a high-quality college, and having prior enlisted service. (Nolan, 1993)

D. SUMMARY

Although the qualitative literature reviewed focused primarily on line officer communities, the basic methodologies can be adapted to study the MSC HCA community. Application for MSC HCS officers is possible if a separate analysis is prepared for each specialty in this diverse community.

The literature reviewed clearly establishes statistical relationships for background factors and MOEs for evaluating officer effectiveness, and it also validates the use of FITREP data for analytical purposes. In each study, the objectives and techniques were different, giving additional perspectives of the issue. Examination of these techniques suggests that there is no singularly correct method to evaluate accession programs or officer performance. There are advantages and disadvantages to each of the methodologies reviewed. Clearly, the method used should consider data availability, time constraints, complexity, and desired outcome. For example, Bowman's measure of a "superior" officer only looks at one point in time and does not present an image of career performance. On the other hand, albeit complicated, the index for officer performance employed by Neuman et al. standardizes the data and assesses an officer over a career.

Since Neuman and her associates use all available data, their method presents a more comprehensive picture of an officer's ability.

Nolan's MOEs use acceptable standards to measure officer productivity. Unfortunately, since the TRAINTRACK system has only been used sporadically, the data are limited, with numerous missing fields. Data tracking MSC's additional qualification designators (AQDs) and inservice professional qualifications have not reached the level of sophistication required for multivariate analysis. Historically, the MSC has employed a "hands-on" approach to monitoring individual officer qualifications. While the personal approach adds to quality of life and enhances job-matching within the MSC, this decentralized system detracts from analysis. The MSC has acknowledged this factor and is taking steps to further develop this data field in the Officer Master File. Although information on professional qualification achievements after entering active duty would enhance this research, it is not essential when comparing the IPP and DP programs. The data and methodologies used in this study will be discussed in the next chapter.

III. DATA AND METHODOLOGY

This chapter identifies data sets and explanatory variables used to answer the questions presented in Chapter I. Variables used to measure officer performance and accession program effectiveness are also described. Finally, the chapter reviews methodologies used to study statistical relationships and obtain the research results.

A. DATA

Three data files were utilized in the statistical analysis. Two officer personnel data files were obtained from the Defense Manpower Data Center (DMDC) and one officer fitness report file was obtained from the Navy Personnel Research and Development Center (NPRDC).

One of the DMDC data files is an extract from the Active Duty Officer Loss File of all officers, with MSC designators (2300 and 2305), who separated from active duty prior to the end of fiscal 1993. Data elements in this file include separation codes, length of service, selected demographics, accession source, and educational levels.

The Loss File initially contained 2,271 observations. Due to questionable data coding, particularly for sub-specialty codes prior to July 1987, only data after the end of fiscal 1987 were used in the analysis. Also due to coding errors, it was not possible to accurately isolate Direct Procurement (DP) and Inservice Procurement Program (IPP) accession sources. Since one of the distinguishing attributes of the IPP is substantial prior enlisted service, categories were created that divided the sample into those with nine or more years of enlisted service (CARENL) and those with less than nine years prior enlisted service (NONCAR). Only observations reporting MSC Health Care Administrator (HCA) sub-specialty codes were retained for regression analysis. Finally, observations with missing data were eliminated from the data set. There were no further restrictions, and 422 observations remained for statistical analysis. Of the 422 observations, 286 were classified as voluntary retirements.

Table I defines the variables used in the regression analysis. Variables used in bivariate and univariate analysis are clearly labeled when presented in their corresponding tables.

TABLE I. Description of Officer Loss File Variables

VARIABLE	DESCRIPTION
ENLTIME	Years of prior enlisted service before commissioning: Continuous values
CARENL	Nine or more years of prior enlisted service: 1 if yes, 0 if no
SOMPRI	Between four and eight years prior enlisted service: 1 if yes, 0 if no
NONPRI	Zero to four years prior enlisted service: 1 if yes, 0 if no
RAD	Voluntary Release from Active Duty prior to retirement; 1 if yes, 0 if no
IRAD	Involuntary Release from Active Duty: 1 if yes, 0 if no
RETIRE	Voluntary Retirement: 1 if yes; 0 if no
MARRIED	Married, without children: 1 if yes, 0 if no
DEPENDS	Married, with children: 1 if yes; 0 if no
HYEC	Years of education: Continuous values
AGECOM	Age at Time of Commissioning: Continuous values
WHITE	Caucasian: 1 if White; 0 if Minority
MALE	Gender: 1 if male, 0 if female
COMSVC	Years of Commissioned Service
USN	Designator 2300: 1 if yes; 0 if 2305

The other DMDC data file is an extract from the Navy Officer Master File including active duty officers with MSC designators at two points in time, the end of fiscal 1987 and the end of fiscal 1993. These periods capture two different snapshots of the MSC force structure. Data elements include educational experience, promotion status, and personal demographics. Personal demographics consist of variables for marital status, age at time of commissioning, gender, racial/ethnic group, prior enlisted service, and commissioning source.

College quality indicators were established using The Gourman Report: A Rating of Undergraduate Programs in American and International Universities and The Gourman Report: A Rating of Graduate and Professional Programs in America and International Universities (sixth editions). Gourman uses the following criteria to establish ratings on a scale of 0.00 to 5.0:

- diversity of programs
- faculty qualifications, experience, achievements, and professional productivity (research)
- student quality, including scholastic work to date
- admission requirements
- number of students enrolled
- curricular content
- academic-to-athletic balance
- experience level (age) of the institution and of the individual program
- library quality
- standards and quality of instruction;
- quality of physical plant
- availability of counseling and placement service

Separate ratings are provided for the overall institution and for specific disciplines within the educational institution. The premise is that a college may have separate standards for entrance into, and eventual graduation from, a particular major. Evaluating each university, by discipline, using the abundance of criteria provides a precise index of

college quality. Criteria are much more rigorous for graduate programs as compared with undergraduate programs. The stringent criteria for graduate schools results in much lower aggregate scores for master's degrees.

Gourman divides ratings into four general categories for undergraduate programs and six general ratings for graduate education programs. Undergraduate school ratings of 4.0 to 5.0 are classified as "excellent"; 3.0 to 3.9 are "very good"; 2.1 to 2.9 are "adequate"; and ratings below 2.1 are "inadequate." Graduate school ratings of 4.51 to 5.0 are classified as "very strong"; 4.01 to 4.49 are "very good"; 3.61 to 3.99 are "good"; 3.01 to 3.59 are "acceptable plus"; 2.51 to 2.99 are "adequate"; and 2.01 to 2.49 are "marginal." Ratings below 2.01 were considered "not sufficient for graduate programs." (Gourman, 1993)

Each college and major in the Officer Master File was given a college quality rating, representing a college quality indicator for each officer's educational accomplishments. Gourman's rating categories were then used to develop three binary variables (HIGHQUAL, MEDQUAL, and LOWQUAL) with values of one for "yes" and zero for "no." For example, a value of one for "HIGHQUAL" indicates that the Gourman rating is between 4.01 and 5.0, and zero would mean that the rating falls in one of the two remaining categories of MEDQUAL (Gourman rating of 2.51 to 4.00) or LOWQUAL (Gourman rating of less than 2.50). This method of coding provided binary variables to simplify regression analysis.

Observations with missing data in key fields (such as sub-specialty code, university level, and pay grade) were eliminated. This partially reduced the sample size, leaving 1,978 observations for the 1987 group and 2,305 for the 1993 group. As in the previous data set, only observations with HCA sub-specialty codes were retained for analysis. The remaining file consisted of 680 observations for 1987 and 1,191 observations for 1993. Using the guidelines of fifteen observations for each variable, these sample sizes are considered adequate for multivariate analysis. (Affifi & Clark, 1990)

The final data set is a longitudinal profile of officer fitness reports obtained from NPRDC. This file has information on each officer's fitness reports (FITREPs) and represents career performance history. The data elements in this file are all fields on an officer FITREP, except for narrative comments.

Junior Navy MSC officers' responsibilities are more specialized and career paths are accelerated when compared with other Naval officer designators and armed services. For example, it is not unusual for a new MSC HCA ensign to become a department head in their initial assignment, with the responsibilities accompanying this level in an organization. The MSC has developed a sophisticated infrastructure of specialty advisors, resulting in career paths that are specifically designed to integrate the Medical Department's needs and the individual's skills and career goals. While this makes for a better "fit" when selecting the right officer for the right job, it complicates analysis of an already complex officer corps. For these reasons, it was deemed appropriate to include only fitness reports based on performance as a Navy MSC. Since a portion of MSC officers are obtained through redesignation, intra-service transfers, and direct procurement of prior-service officers, only FITREPs reporting on designators 2300, 2302, and 2305 were used. This allowed for elimination of performance measures that were not specific to the MSC.

In addition, only fitness reports reflecting that the reporting senior had "close" or "frequent" observation of the officer were used; and only regular, periodic, and detaching senior fitness reports were retained. These restrictions ensured that officers in the sample were graded against their peers in the command and that the reporting senior was knowledgeable about an officer's performance. Although these constraints resulted in the loss of 15 percent of the 57,400 fitness reports contained in the file, they corrected for potential bias in the data and provide a more accurate depiction of the officer's performance.

The remaining observations were sub-divided by pay grade to form six data sets, representing ranks ensign through captain. Occurrence ratios were designed for each of the graded variables to establish the percentage of times that an officer received the highest rating possible while serving within that pay grade. Similar to Neumann's findings, there was a linear relationship between pay grade and the ratios obtained. (Neumann, et al., 1989) Although looking at all possible fields is helpful when developing a complete picture of officer performance, the recommendation for early promotion had the widest range of results. Additionally, a recommendation for early promotion is believed to distinguish outstanding performers from their peers. (Bjerke, et al., 1987) Given these indicators, a ratio of the number of recommendations for early promotion was selected for use in statistical analysis as the key indicator of officer performance.

Ratios for early promotion recommendations were consolidated to represent different points of an officer's career, based upon years of commissioned service. These sub-categories represent different "stay or leave" decision points. There are three different "stay or leave" decision points for MSCs, depending upon the years of prior service that an officer has completed when he or she is commissioned. The most obvious decision point is upon completion of initial obligated service, which is generally three years. This decision point is most critical for officers who are commissioned with no prior service. On the other hand, officers who are commissioned with at least ten years of prior service as an enlistee do not find this to be a critical juncture in deciding whether to stay or leave. Officers with significant prior service face their most critical decision point when they become retirement eligible, usually at ten years of commissioned service. The last decision point is for those with at least ten years of commissioned service and twenty years of total active duty service.

Following this premise, the following fitness report sub-categories were developed based on years of commissioned service: more than three and less than four years (PRCTEP3); more than ten but less than twelve years (PRCTEP10); and all observed

fitness reports (PRCTEP). Since the data file did not identify which officers received entry grade credit, years of service was used to establish categories for this step. Entry grade credit is given to officers with qualified advanced degrees and a number of HCAs enter commissioned service as a lieutenant junior grade with substantial time in grade. This can result in promotion to lieutenant within the first year of service. Because of the practice of assigning entry grade credit, years of commissioned service rendered a more realistic and unbiased basis for comparison. When classification of the fitness report data were completed, these data were merged with the Officer Master File (OMF) by matching a "pseudo" social security number assigned by DMDC. Merged data resulted in 19,750 observed HCA FITREPs. These data were not merged with the Loss File extract. Table II defines the variables selected from this data file for statistical analysis.

Ultimately, two data files were created for this thesis from the extracts provided by DMDC and NPRDC. One file isolates loss information and the other contains personal and performance data on active duty officers. Although only a portion of available variables are discussed in this study, additional descriptive data are presented in Appendix A.

TABLE II. Description of Merged Officer Master File Variables

VARIABLE	DESCRIPTION
PRCTEP	Percent of FITREPs recommending early promotion over career of commissioned service: Continuous values from 0 to 1
PRCTEP3	Percent of FITREPs recommending early promotion upon completing more than 3 and less than 4 years of commissioned service: Values 0 to 1
PRCTREP10	Percent of FITREPs recommending early promotion upon completing at least 10 but no more than 12 years of commissioned service: Values 0 to 1
DP	Direct Procurement: 1 if yes, 0 if no
IPP	Inservice Procurement: 1 if yes; 0 if no
BSDEG	Bachelor's degree earned: 1 if yes, 0 if no
MSDEG	Master's degree earned: 1 if yes; 0 if no
HIGHQUAL	High college quality, based on Gourman's ratings between 4.01 and 5.0: 1 if yes; 0 if no
MEDQUAL	Medium college quality, based on Gourman's ratings between 2.51 and 4.00: 1 if yes; 0 otherwise
LOWQUAL	Low college quality, based on Gourman's ratings less than 2.5: 1 if yes; 0 otherwise
QUALMAJ	College major in health care, management, or administration, qualified for commissioning in the MSC HCA: 1 if yes 0 if no

TABLE II. Description of Merged Officer Master File Variables (Continued)

VARIABLE	DESCRIPTION
AGECOM	Age at time of commissioning: Continuous values from 22 to 35
SWKIDS	Single, with dependents: 1 if yes 0 if no
MILWKIDS	Married to a military spouse, with children, 1 if yes o if no
MWKIDS	Married, with or without children: 1 if yes 0 if no
MALE	Gender: 1 if male, 0 if yes, 0 if female
WHITE	Caucasian: 1 if yes 0 if no
COMSVC	Years of commissioned service completed: Continuous value from 0 to 30
NONPRI	Completed zero to four years prior enlisted service: 1 if yes, 0 if no
SOMPRI	Completed over four and less than nine years prior enlisted service: 1 if yes, 0 if no
CARENL	Completed more than 9 years of enlisted service: 1 if yes, 0 if no
USN	Designator 2300: 1 if yes 0 if 2305
GREAT	PRCTEP above the mean value; 1 if yes 0 if no
FOS	Failed to be selected for promotion: 1 if yes 0 if no

B. METHODOLOGY

1. Univariate Analysis

Descriptive statistics are developed for each of the elements in the data files used for this thesis. Frequency distribution tables and estimates to evaluate skewness and kurtosis are derived for continuous and discrete variables. Skewness and kurtosis provide information about the distribution of the data in terms of whether the values tend toward upward or lower limits, or if there is a normal, bell-shaped distribution. Corrections to control for outliers in the data are employed, when indicated. Arithmetic means are presented for continuous variables. As previously observed, only selected variables are presented in the body of this thesis.

2. Bivariate Analysis

Within the merged OMF and FITREP file, frequency distribution tables divide the accession paths into two categories and compare their similarities and differences. Sub-categories are determined by the time frame of the data file's ending date. This process results in four unique portrayals of the MSC HCA community. The first two "snapshots" show MSC HCAs accessed through IPP and DP as of the end of fiscal 1987. The third and fourth portraits present MSC HCAs accessed through IPP and DP as of the end of fiscal 1993. The end of fiscal 1987 was chosen to give a picture of the MSC before the IPP required a bachelor's degree. The second time period, the end of fiscal 1993, is before the latest policy change that allows IPP accessions to be increased from 25 to 50 percent of total HCA accessions, and six years after the IPP's minimum educational requirement was raised to a bachelor's degree. Comparing fiscal 1987 and 1993 snapshots allows for an assessment of the effect of the 1987 policy changes on force structure and establishes a baseline for future research regarding fiscal 1995 policy changes. Cross-tabulation of explanatory variables by procurement source provides information about trends contained in the data.

3. Selectivity Bias

Since selectivity bias can be present in any "non-random selection" into a group, procedures are used to test and control for this factor. (Barnow, 1980) Controls are only engaged if indicated. Bias refers to mis-estimation of program effectiveness. Selectivity bias results from selection behavior, either on the part of an individual or a group of individuals. Even though the selection process occurs before the individual enters the military, the factors causing bias may indirectly affect officer performance and retention. If the bias has a strong enough effect, it can skew the analysis of causality and may result in the conclusion that a program is successful, when that success is really attributable to the individual, rather than the program. If the bias effect is *statistically* insignificant, then it may be overlooked. Regardless of the outcome, its potential impact must be addressed. (Barnow, 1980)

Two types of selectivity bias are possible. The first results from the tendency of an individual with a particular background to decide between two or more alternatives and is referred to as "self-selection." Self-selection bias may be present if unobservable factors affect the decision process. Some examples of unobservable factors are desire to serve in the military, motivation, and attitude.

Another form of selectivity bias is the tendency of a group of people to consistently choose individuals with similar qualities. Accession selection boards actively attempt to select only the best qualified people, using standard selection criteria. Regardless of measurable standards, human nature invokes a tendency for people to select others that they perceive to be like themselves. Since the MSC uses a restrictive program authorization and consistent selection board membership, selection into the MSC is not a random process, making selectivity bias probable.

There are several ways to deal with selectivity bias. Since Statistical Analysis Software (SAS), which is employed extensively throughout this study, is designed to be used with large data sets and is very advanced, there is some latitude in choosing a procedure to test for and control bias, if controls are needed. Regardless of the statistical procedure used, if the selection process is not clearly defined, specification bias may

occur. Inaccurately defining the factors to be included in the analytical selection model may cause misleading estimates. Although specification bias can be easily controlled, once detected, it is another potential area of bias. Tests for model specification bias are automatically done in the analytical process and will not be discussed here.

The Heckman procedure is a two-stage process designed by James J. Heckman to deal with selectivity bias. (Bowman, 1990) In the first stage, selection into treatment and comparison groups is modeled using non-linear probit analysis, with at least one explanatory variable in the "treatment" model that does not affect the outcome of the actual selection model. This step produces a coefficient estimate of a correction factor referred to as LAMBDA. LAMBDA places a numerical value as an "error term" and accounts for the unobserved factors present in the selection model. If LAMBDA is *statistically* insignificant, no additional steps are required. The second stage uses LAMBDA as a regressor along with the treatment variable and other factors related to the outcome in a linear regression model (ordinary least squares). This process provides a multiple regression model that accounts for those characteristics that are not observable, but are correlated to the selection model. (Heckman, 1979)

Another difficulty with selection bias results when being in a group causes the behavior that is being evaluated. For example, the high selection requirements for being selected into the MSC may lead to high performance. If this inter-dependent relationship is strong enough, it violates the assumption that the error term and the explanatory variables of the regression model are independent of each other. This inter-dependence is referred to as endogenity. Burt Barnow et al. developed a method of dealing with this situation using a two stage method that is similar to the Heckman procedure. Instead of using LAMBDA in the second model, the predicted value obtained from the first model is used in place of the "treatment" explanatory variable. This displaces the endogeneity and correlation with the error term. (Barnow, 1980)

A less complicated alternative to the Heckman and Barnow procedures is to include "proxy" variables in the model to better account for the selection process. This does not test for or measure the magnitude of the bias. As a result, the model must be carefully evaluated to ensure that there is "goodness of fit" within the explanatory variables. Using this method combined with other measures of model suitability provides an acceptable level of confidence that the model is appropriate. All three methods are used in this study to attempt to identify and correct for selectivity bias. The method is determined by the model and the relationship between the explanatory and dependent variables.

4. Multivariate Analysis

Multivariate regression analysis is a valuable statistical technique and shows the impact of incremental changes in an explanatory variable on a dependent variable, holding everything else constant (*ceterus paribus*). The explanatory variables "explain" the reasons for the value obtained in the dependent variable (value being measured). For example, the years of commissioned service that an individual chooses to serve may be explained as a "function of" variables (i. e., age or education) believed to affect the decision to stay or leave, *ceterus paribus*.

Models to estimate the effectiveness of officer accession programs are based upon retention, performance, and college quality using the merged officer master file (OMF) and loss data sets. Ordinary least squares (linear relationship models) and logit (probability models) multivariate regression methods are utilized in this study. Neither is intrinsically better than the other, but serve different purposes.

Ordinary least squares regression models, using loss file data, estimate retention as measured by time of commissioned service and the decision to stay beyond the critical "stay or leave" decision points previously presented. This is evaluated by the continuous dependent variable for total years of commissioned service (COMSVC), regressed against applicable explanatory variables. This process establishes linear relationships between the dependent and the explanatory variables, *ceterus paribus*. Within the OMF, ordinary least

squares regression models were developed to estimate performance using a continuous variable for percent of recommendations for early promotion (PRCTEP, PRCTEP3, and PRCTEP10) obtained from fitness report data.

Logit models are designed to gauge probabilities for retention and performance, using a variety of explanatory variables, including college quality ratios. Specific to the loss file, proportional hazard general linear and logit models are designed to estimate the effect of prior enlisted service, *ceterus paribus*. The following separation categories are used: voluntary retirement (RETIRE); voluntary release from active duty and resignation of commissions (RAD); and involuntary release from active duty (IRAD). Involuntary release from active duty includes all reasons for involuntary separation and involuntary retirements for statutory or medical reasons.

Using data elements from OMF, performance is evaluated using logit models. The failure to be selected for promotion (FOS) model is restricted to officers who were reviewed for promotion to lieutenant commander, commander, or captain and were either selected or "passed over." Binary variables for FOS are used with a value of one if selected and zero, if not selected. Three categories are established based upon pay grade: pooled sample of HCAs who were screened for lieutenant commander, commander, and captain; HCAs who were screened for lieutenant commander; and HCAs who were screened for commander and captain. Since promotion opportunity for lieutenant has historically remained above 95 percent, HCAs who screened for promotion to lieutenant are not evaluated. Pay grades of commander and captain are selected as a separate category due to the lower opportunity for promotion (65-70 and 50 percent for commander and captain, respectively), high standards set for these boards, and the increased variety of a variables that may affect the selection board's decision.

Finally, logit models are designed to identify superior performers by assessing the probability of having percent ratio of early recommendations for promotion above the mean value of career fitness reports (GREAT). Career fitness reports were standardized

to equally weigh the number of fitness reports received. Table III presents the regression models used in the multivariate analyses. Variables are defined in Tables I and II, above.

TABLE III. Multivariate Models

Officer Loss File

Ordinary Least Squares Models:

COMSVC = f (USN, HYEC, DEPENDS, AGECOM, WHITE, MALE, ENLTIME)

Proportional Hazard General Linear Models:

RAD = f (USN, HYEC, DEPENDS, MARRIED AGECOM, MALE, WHITE, ENLTIME),

RETIRE = f (USN, HYEC, DEPENDS, MARRIED, AGECOM, MALE, WHITE, ENLTIME)

Logit Models:

IRAD = f (HYEC, DEPENDS, MARRIED, AGECOM, MALE, WHITE, NONPRI, SOMPRI)

RAD = f (HYEC, DEPENDS, MARRIED, AGECOM, MALE, WHITE, NONPRI, SOMPRI)

RETIRE = f (HYEC, DEPENDS, MARRIED, AGECOM, MALE, WHITE, NONPRI, SOMPRI)

Merged Officer Master File

Ordinary Least Squares Models:

PCTEP = f (HIGHQUAL, MEDQUAL, MSDEG, BSDEG, QUALMAJ, DP, IPP, SWKIDS, MARRIED, AGECOM, MALE, WHITE, ENLTIME)

PCTEP3 = f (HIGHQUAL, MEDQUAL, MSDEG, BSDEG, QUALMAJ, DP, IPP, SWKIDS, MARRIED, AGECOM, MALE, WHITE, ENLTIME)

PCTEP10 = f (HIGHQUAL, MEDQUAL, MSDEG, BSDEG, QUALMAJ, DP, IPP, SWKIDS, MARRIED, AGECOM, MALE, WHITE, ENLTIME)

Logit Models:

FOS = f (USN, HIGHQUAL, MEDQUAL, MSDEG, BSDEG, QUALMAJ, DP, IPP, DEPENDS, AGECOM, MALE, PRCTEP, ENLTIME)

GREAT = f (USN, HIGHQUAL, MEDQUAL, MSDEG, BSDEG, QUALMAJ, DP, IPP, DEPENDS, AGECOM, MALE, WHITE, ENLTIME)

IV. RESULTS

This chapter summarizes the bivariate and multivariate analyses of two data sets, the loss file and the merged officer master file. First, the loss file data analysis is presented and retention models are discussed. Then, the merged officer master data are evaluated and regression model results are discussed to assess performance and college quality factors. Data used in this study represent specific points in time. Longitudinal cohort data were not employed in this analysis.

Bivariate analysis examines the frequency distribution of the dependent and explanatory variables used in the multivariate analysis. Cross-tabulating variables reveals trends within the data. Frequency tables describe the structure of the MSC HCA community at the end of fiscal 1987 and the end of fiscal 1993. Although there are numerous OMF variables, only factors believed to influence this study are considered here. Additional descriptive variables are presented in Appendix A to offer a more complete picture of the MSC HCA force.

Multivariate analysis results (from the models described in Chapter III) are shown for each data set. Retention models are presented within the discussion of loss file data. Performance models are presented within the officer master file data section. An estimate of the influence of college quality and educational level is incorporated within all performance models. Changes in probabilities based upon a one-unit change in the explanatory variable, holding all other variables constant, are calculated and provided in the tables to assist in interpreting the results of the logit regression models. Tables displaying the signs and magnitudes of the estimated coefficients are presented for each of the models. Standard errors are displayed instead of t-statistics, but statistically significant variables at the 95 percent confidence level are annotated with an asterisk.

A. OFFICER LOSS FILE

This section presents the results of the separation data analysis for the 422 observations retained from the Officer Loss File. Two primary categories of personnel are established based upon years of prior enlisted service. These categories allow for the analysis of the influence of having substantial prior enlisted service on the officer's decision to stay for retirement; and, if they decide to stay for retirement, how long they should stay. Bivariate methods were used to evaluate these decisions. Multivariate analysis was used to evaluate this decision and any other factors that may influence the decision process.

1. Bivariate Analysis

This section presents the mean values and frequency distributions of dependent and explanatory variables. Table IV displays percentage distributions and arithmetic mean values for variables contained in the loss file and used in this study. Percentage distributions are presented for binary variables and mean values are presented for continuous variables. Personnel losses are divided into three categories, used in the cross-tabulation presented in Table IV: (1) officers with over nine years of prior enlisted service (CARENL); (2) officers with zero to eight years of prior enlisted service (NONCAR); and (3) full sample size.

Table IV indicates that there are two distinctive separation trends between officers in the two categories of CARENL and NONCAR. These trends were used to identify explanatory variables that would best explain behavior when developing multivariate models. Analysis of the pooled sample of HCA separations provides the following noteworthy findings:

- 70.2 percent of all HCAs stay to retirement, with an average of 20.5 years total federal service.

- HCAs leave the Navy with an average 14.1 years of commissioned service with pay grades between lieutenant and lieutenant commander.

- The average length of prior enlisted service is 6.8 years.

- The average age at time of commissioning is 28.9 years.

- 60.9 percent of the HCAs within this sample have at least a master's degree.

Comparing HCAs with more than nine years of prior enlisted service (CARENL) to those with less than nine years of prior enlisted service (NONCAR) gives the following results:

- 44.1 percent of all HCAs who separated from the Navy were CARENL.

- CARENL HCAs are on the average 3.7 years older than NONCAR HCAs.

- CARENL average 11.3 years of prior enlisted service, while NONCAR average 3.0 years of prior enlisted service.

- 94.6 percent CARENL and 53.0 percent NONCAR HCAs were regular Navy.

- 7.3 percent CARENL HCAs did not have a college degree.

- 21.1 percent CARENL and 37.9 percent NONCAR had at least a master's degree.

- 8.1 percent NONCAR compared to 1.2 percent CARENL left the Navy involuntary.

- 42.7 percent CARENL voluntarily retire compared to 27.5 percent NONCAR HCAs.

Much of the "early" separation and involuntary separation behavior of HCAs with less than nine years of service may be attributed to their obtaining regular Navy status. Since officers accessed through the IPP are automatically granted regular Navy status and usually have more than nine years of prior enlisted service, their "tenure" with the military alters their decision to stay or leave. On the other hand, officers with less than nine years of prior enlisted service and constrained opportunities to obtain regular Navy status have less to lose, with respect to human capital investment, by leaving at the end of their obligated service. The influence of regular Navy status may be revealed in the analysis of the multivariate models, which hold everything thing else constant while assessing the impact of individual variables.

TABLE IV. Selected Explanatory Variables for HCAs Who Separated From the Navy Between Fiscal 1987 and 1993, By Prior Enlisted Service Categories

SELECTED VARIABLES	ALL HCAs (N=422)	NINE OR MORE YEARS ENLISTED SVC (N=186)	LESS THAN NINE YEARS ENLISTED SVC (N=236)
SEPARATION CATEGORIES			
VOLUNTARY RETIREMENT	70.2%	42.7%	27.5%
VOLUNTARY SEPARATION	20.6%	0.2%	16.6%
INVOLUNTARY SEPARATION	9.2%	1.2%	8.1%
PERSONAL DEMOGRAPHICS			
REGULAR NAVY (USN)	71.3%	94.6%	54.3%
MALE	89.2%	92.3%	84.5%
NUMBER OF DEPENDENTS	2.3	2.6	2.1
AGE AT TIME OF COMMISSIONING (YEARS)	28.8	30.9	27.2
AGE AT TIME OF SEPARATION (YEARS)	42.4	46.7	39.0
PAY GRADE (0-1 THROUGH 0-6)	3.9	4.2	3.8
YEARS IN GRADE	4.9	5.3	4.6
YEARS ON ACTIVE DUTY	20.5	26.5	15.8
YEARS OF PRIOR ENLISTED SERVICE	6.8	11.7	3.0
YEARS COMMISSIONED	14.1	16.3	12.3
EDUCATION BACKGROUND			
YEARS OF EDUCATION	17.0	16.6	17.4
NO COLLEGE DEGREE	9.2%	7.5%	1.7%
BACHELOR'S DEGREE	29.9%	15.6%	14.3%
MASTER'S DEGREE	58.8%	20.9%	37.9%
PH.D.	2.1%	0.2%	1.9%

Note: Numbers shown are the means (or averages) for the respective subgroups.

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.

HCAs who separated from the Navy can also be examined by their average years of commissioned service, pay grade, and reason for separation, as displayed by Table V. This information shows the following:

- 31 percent of HCAs remain in the Navy to complete a career of twenty years of commissioned service.

- 15.5 percent of all HCAs who retire do so at the grade of lieutenant with an average of ten years of commissioned service.

- 24.6 percent of all HCAs who retire do so at the grade of lieutenant commander with an average of fifteen years commissioned service.

- 39.5 percent of all losses are lieutenants.

- 16.7 percent of all losses are lieutenants who are voluntarily released from active duty, with an average of 4.6 years of commissioned service.

TABLE V. Mean Years of Commissioned Service for HCAs Who Separated From the Navy Between Fiscal 1987 and 1993, By Pay Grade and Reason For Separation

PAY GRADE	RETIRE (N=296)	RAD (N=71)	RESIGN (N=16)	IRAD (N=39)	ALL REASONS
ENSIGN	------	1.0	------	------	1.0
LIEUTENANT JUNIOR GRADE	------	2.6	------	3.4	3.2
LIEUTENANT	10.3	4.6	6.7	8.4	7.6
LIEUTENANT COMMANDER	15.6	18.0	------	------	15.5
COMMANDER	20.1	------	------	------	20.1
CAPTAIN	25.9	------	------	------	25.9

Note: Blank fields indicate that there were no observations for that category.

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.

RETIRE = Voluntary retirement

RAD = Voluntary release of reserve officer (USNR) from active duty

RESIGN = Resignation of regular Navy officer (USN) commission

IRAD = Involuntary release from active duty, USN and USNR officers

TABLE VI. Percentage Distribution of HCAs Who Separated From the Navy Between Fiscal 1987 and 1993, By Pay Grade and Reason for Separation

PAY GRADE	RETIRE (N=296)	RAD (N=71)	RESIGN (N=16)	IRAD (N=39)	ALL REASONS
ENSIGN	0.0	0.0	0.0	0.2	0.2
LIEUTENANT JUNIOR GRADE	0.0	2.1	0.2	1.2	3.5
LIEUTENANT	15.5	14.4	2.4	7.2	39.5
LIEUTENANT COMMANDER	24.6	0.2	0.8	0.2	25.8
COMMANDER	16.8	0.0	0.2	0.0	17.0
CAPTAIN	13.0	0	0.2	0.8	14.0
TOTALS (N=422)	69.9	16.7	3.8	9.6	100.0

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.
RETIRE = Voluntary retirement
RAD = Voluntary release of reserve officer (USNR) from active duty
RESIGN= Resignation of regular Navy officer (USN) commission
IRAD = Involuntary release from active duty, USN and USNR officers

2. Multivariate Analysis

Three types of multivariate models (discussed in Chapter III) evaluate the effect of prior enlisted service, years of education, and age at time of commissioning on separation behavior. Ordinary least squares techniques are used to evaluate the continuous variable for years of commissioned service. A proportional hazards general linear model (PHGLM) generates estimated years of commissioned service before retirement (RETIRE) or being voluntarily released from active duty (RAD). Finally, binary variables for RETIRE, RAD, and involuntary release from active duty (IRAD) are estimated using a logit maximum likelihood estimation technique.

Table VII displays the results of the OLS estimates for the years of commissioned service (COMSVC) model. This table combines the results of models for three categories of all HCAs who separated between 1987 and 1993: all HCAs (pooled sample); HCAs who have more than nine years of enlisted service (CARENL); and HCAs who have between zero and eight years of enlisted service (NONCAR). Results are presented in the same table to assist with comparing the estimated coefficients of the three models. Each coefficient estimates the effect of the explanatory variable on COMSVC, holding everything else constant. Age at time of commissioning (AGECOM) and being married with dependents (DEPENDS) are consistently significant in all three models. AGECOM has a consistent negative influence on years of commissioned service. Interpretations of the coefficients are:

- Pooled sample
  - regular Navy status increases COMSVC by 10.3 years
  - being married with dependents decreases COMSVC by 0.42 years
  - being male increases COMSVC by 2.5 years
  - every additional year of AGECOM decreases COMSVC by 0.50 years
  - every additional year of prior enlisted service increases COMSVC by 0.22 years
- CARENL sample
  - being married with dependents decreases COMSVC by 1.69 years
  - being male increases COMSVC by 7.45 years
  - every additional year of AGECOM decreases COMSVC by 0.72 years

- NONCAR sample
  - regular Navy status increases COMSVC by 11.13 years
  - every additional year of education increases COMSVC by 0.7 years
  - being married with dependents increases COMSVC by 0.51 years
  - every additional year of AGECOM decreases COMSVC by 0.45 years
  - every additional year of prior enlisted service increases COMSVC by 0.29 years

The models signify the value of attaining regular Navy status in the decision to remain on active duty. Since all CARENL HCAs had attained this status (presumably as result of being commissioned through the IPP), it was not significant. The increased significance of AGECOM in the CARENL model may be attributed to the higher mean age of this group. These findings correspond to the bivariate results, which indicate that CARENL officers usually retire within a few years of reaching eligibility for retirement.

TABLE VII. Ordinary Least Squares Model of the Estimated Effect of Prior Enlisted Service on Years of Commissioned Service for the Pooled Sample of All HCAs

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES POOLED SAMPLE	COEFFICIENT ESTIMATES CARENL	COEFFICIENT ESTIMATES NONCARI
USN	10.27 (0.77) *	3.17 (1.86)	0.13 (0.90) *
HYEC	0.43 (0.19) *	0.09 (0.26)	0.70 (0.25) *
DEPENDS	-0.42 (0.20) *	- 1.69 (0.31) *	0.51 (0.02) *
MARRIED	0.27 (0.83)	1.76 (1.40)	- 1.21 (0.94)
WHITE	0.89 (0.95)	0.87 (1.58)	0.61 (0.95)
MALE	2.47 (0.99) *	7.45 (3.22) *	0.56 (0.96)
AGECOM	-0.50 (0.11) *	- 0.72 (0.29) *	- 0.45 (0.12) *
ENLTIME	0.22 (0.09) *	0.16 (0.28)	0.29 (0.12) *
R-Square	0.51	0.25	0.67
F-value	54.56	7.6	57.71
Durbin Watson	1.892	1.946	2.031

* Statistically significant at the 95 percent confidence level

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.

The coefficients obtained from the PHGLM regression do not vary significantly from the OLS models, and are provided in Appendix B. Table VII presents the results of the PHGLM model's linear distribution of predicted HCA losses, based upon years of prior enlisted service and reason for separation (RETIRE or RAD). The estimated loss rates confirm findings of the bivariate analysis and OLS models. Officers with less than nine years of prior enlisted service show comparatively high RAD rates between three and six years of commissioned service, and begin to gradually RETIRE after twelve years COMSVC, with 32 percent staying to retire after twenty years COMSVC. Over 26 percent of CARENL HCAs retire at ten years COMSVC, with 29 percent staying for twenty or more years COMSVC. Despite early separation decisions (RAD), hazard rates of CARENL officers surpass NONCAR hazard rates at the twelve-year point, until the twenty-year point.

TABLE VIII. Estimated Hazard (Predicted Loss) Rates for HCAs Who Separate from the Navy by Retirement or Voluntary Release from Active Duty, By Categories of Prior Enlisted Service and Years of Commissioned Service

	NINE OR MORE YEARS PRIOR ENLISTED SERVICE			LESS THAN NINE YEARS PRIOR ENLISTED SERVICE		
YEARS COMMISSIONED	RETIRE	RAD	CUMULA-TIVE TOTALS	RETIRE	RAD	CUMULA-TIVE TOTALS
0-3	0.0	0.0	0.0	0.0	0.14	0.14
4-5	0.0	0.0	0.0	0.0	0.10	0.24
6-7	0.0	0.0	0.0	0.0	0.10	0.34
8-9	0.06	0.0	0.06	0.0	0.0	0.34
10-11	026	0.0	0.32	0.0	0.0	0.34
12-13	0.13	0.0	0.45	0.08	0.0	0.42
14-15	0.06	0.0	0.51	0.06	0.0	0.48
16-17	0.08	0.0	0.59	0.10	0.0	0.58
18-19	0.12	0.0	0.71	0.10	0.0	0.68
20-21	0.07	0.0	0.78	0.13	0.0	0.81
22 OR MORE	0.22	0.0	1.00	0.19	0.0	1.00

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.

Tables IX through XI display the results of the logit estimates for RETIRE, RAD, and IRAD. All models use pooled samples. Due to the minimal numbers of CARENL who RAD and IRAD, comparing prior enlisted service categories did not provide statistically significant models. Binary variables for years of prior enlisted service, NONPRI and SOMPRI, are regressed against the separation categories using CARENL officers as the base for comparison. Both NONPRI and SOMPRI are statistically significant and represent the largest influence in all three models. As anticipated, they have positive signs in the RAD and IRAD models and negative signs in the RETIRE model.

Analysis of the RETIRE model's coefficients indicate that NONPRI and SOMPRI are respectively 98 percent and 67 percent less likely to retire than CARENL. Men are 38 percent more likely to retire than women. The RAD model indicates that NONPRI are 93 percent more likely to RAD than CARENL, while SOMPRI are 55 percent more likely than CARENL to RAD. HCAs who are married with children are 11 percent less likely to RAD than those who are single or married without children. Finally, NONPRI are 20 percent more likely to IRAD than CARENL, and SOMPRI are 23 percent more likely to IRAD. HCAs who are married without children are 8 percent less likely to IRAD than HCAs who are single.

TABLE IX. Logit Model Estimating the Probability of Retirement for Pooled Sample of All HCAs

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES	CHANGE IN PROBABILITY
YEARS OF EDUCATION	0.03 (0.11)	0.006
MARRIED WITH CHILDREN	0.30 (0.12) *	0.063
MARRIED WITHOUT CHILDREN	0.19 (0.48)	0.039
WHITE	1.79 (0.57) *	0.044
MALE	1.10 (0.53) *	0.375
AGE WHEN COMMISSIONED	- 0.21 (0.06) *	- 0.231
FOUR OR LESS YEARS PRIOR SERVICE	- 4.86 (0.64) *	- 0.978
FIVE-NINE YEARS PRIOR SERVICE	- 3.22 (0.55) *	- 0.674
Chi-Square	223.94	
Concordant ratio	91.1	

* Statistically significant at the 95 percent confidence level

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.

TABLE X. Logit Model Estimating the Probability of Voluntary Release from Active Duty for Pooled Sample of All HCAs

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES	CHANGES IN PROBABILITY
YEARS OF EDUCATION	0.01 (0.14)	0.023
MARRIED WITH CHILDREN	- 0.73 (0.18) *	- 0.119
MARRIED WITHOUT CHILDREN	0.91 (0.54)	0.150
WHITE	- 1.48 (0.63) *	- 0.013
MALE	- 0.44 (0.51)	- 0.242
AGE WHEN COMMISSIONED	0.08 (0.06)	0.072
FOUR OR LESS YEARS PRIOR SERVICE	5.74 (1.10) *	0.929
FIVE-NINE YEARS PRIOR SERVICE	3.38 (1.09) *	0.554
Chi-Square	210.41	
Concordant ratio	93.5	
* Statistically significant at the 95 percent confidence level		

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.

TABLE XI. Logit Model Estimating the Probability of Involuntary Release from Active Duty for Pooled Sample of All HCAs

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES	CHANGE IN PROBABILITY
YEARS OF EDUCATION	- 0.04 (0.14)	-0.003
MARRIED WITH CHILDREN	0.19 (0.18)	0.018
MARRIED WITHOUT CHILDREN	- 0.90 (0.54) *	- 0.083
WHITE	- 0.27 (0.63)	- 0.015
MALE	- 0.10 (0.51)	- 0.025
AGE WHEN COMMISSIONED	0.16 (0.06) *	0.009
FOUR OR LESS YEARS PRIOR SERVICE	2.24 (1.10) *	0.203
FIVE-NINE YEARS PRIOR SERVICE	2.56 (1.09) *	0.233
Chi-Square	32.21	
Concordant ratio	75.5	
* Statistically significant at the 95 percent confidence level		

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.

B. MERGED OFFICER MASTER FILE

This section provides the results of the analysis of performance and quality of education, using 680 observations from the end of fiscal 1987 data and 1190 observations from the end of fiscal 1993. The merged OMF establishes three categories of HCAs based upon procurement source: direct procurement (DP); inservice procurement (IPP); and other procurement sources (OTHER). Other procurement sources include a variety of accession programs, with little commonality, and represent less than 10 percent of all HCA accessions. Officers from other procurement sources are not addressed in this study. Bivariate methods compare the IPP and DP officers at the end of fiscal 1987 and end of fiscal 1993. Multivariate analysis utilizes data from the end of fiscal 1993 data and assesses the influence of DP and IPP procurement sources and education on performance, holding everything else constant.

1. Bivariate Analysis

Mean values and frequency distributions of dependent and explanatory variables are cross-tabulated against DP and IPP categories and examined as of 1987 and 1993. Table XII displays percentage distributions for binary variables, and Table XIII presents means and standard deviations for continuous variables. Data are separated to facilitate analysis. Data from all HCA procurement sources are displayed in the "pooled data" category to provide another basis for comparison of the DP and IPP.

Table XII shows that the HCA force structure has experienced some significant changes from the end of fiscal 1987 to the end of fiscal 1993, both in the aggregate and within the two categories of DP and IPP. Significant trends between the IPP and DP are identified and determine which explanatory variables would best explain behavior when developing multivariate models.

Comparative analysis of the pooled samples from 1987 and 1993 provide the following findings:

- female representation has increased from 15.6 to 19.5 percent
- black representation has increased from 5.3 to 7.5 percent
- HCAs with more than four years of prior enlisted service have decreased from 61.4 to 56.9 percent
- levels of education have increased; and the percentage of HCAs with a master's degree increased by 10.5 percent
- overall college quality has increased
- the percentage of HCAs with a management or administrative degree has increased
- average years of commissioned service has increased by almost 4 years
- performance based upon fitness report data has apparently improved

These findings indicate that HCAs are consistently increasing educational levels and quality, while the proportion of personnel with prior enlisted service has declined. Racial and gender composition is changing to meet or exceed projected Navy-wide goals. These trends remain consistent when comparing the IPP and DP at the end of fiscal 1987 and the end of fiscal 1993.

Comparisons of IPP and DP as of 1987 and 1993 reveal approximately the same differences between the two categories. Using the more recent time frame, the end of fiscal 1993, a comparison of the IPP and DP shows the following:

- male representation in the IPP is 13 percent higher than the DP
- black representation is 5 percent lower in the IPP than in the DP
- all IPPs receive regular Navy (USN) commissions; DP is 58.5 percent USN

- 77.8 percent of IPPs and 23.8 percent of DPs have over nine years of prior enlisted service

- 22.2 percent of IPPs and 30.1 percent of DPs have between four and eight years of prior enlisted service

- 82.3 percent of IPPs and 66.5 percent of DPs are married with children

- 11.2 percent of IPPs do not have a college degree

- 46 percent of IPPs and 64 percent of DPs have a master's degree or further graduate education

- 83 percent of IPPs and 90 percent of DPs have a degree in health care, business, or public administration/management

- fitness report ratios of recommendations for early promotion in the first ten years of commissioned service are higher for DPs

Data concerning HCAs who have between zero and four years of prior enlisted service are contained in Appendix A. This group of HCAs are all accessed through the DP or OTHER sources and are not addressed separately in the analysis. However, the data do represent a sub-section of the DPs and are provided as a reference. Additional comparisons of IPP and DP fitness report data are also included in Appendix A. These data are presented in the multivariate analysis and are not included in the body of this study, but are provided as a reference.

TABLE XII. Percentage Distribution of Merged Officer Master File Explanatory Binary Variables, By Accession Category

	DATA AS OF END 1987			DATA AS OF END 1993		
VARIABLE	**DP (53.6)**	**IPP (35.7)**	**POOLED DATA**	**DP (57.7%)**	**IPP (32.9%)**	**POOLED DATA**
EDUCATION						
NO DEGREE	0.0	24.3	8.9	0.0	11.2	3.7
B.S. DEGREE	44.5	44.2	41.0	36.1	42.6	36.4
M.S. DEGREE	54.6	31.5	49.8	63.0	46.2	59.3
PHD	0.9	0.0	0.3	0.9	0.0	0.6
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
HIGH COLLEGE QUALITY	26.9	40.8	35.0	24.8	34.7	30.7
MEDIUM COLLEGE QUALITY	36.7	29.8	32.5	41.8	37.5	39.2
LOW COLLEGE QUALITY	36.4	29.4	32.7	33.4	27.8	30.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
MANAGEMENT OR ADMIN MAJOR	91.1	75.2	85.9	90.1	82.9	89.1
OTHER COLLEGE MAJOR	8.9	24.8	14.1	9.9	17.1	11.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
PERSONAL DEMOGRAPHICS						
MALE	78.9	91.9	84.4	75.4	88.1	80.5
FEMALE	21.1	8.1	15.6	24.6	11.9	19.5
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

TABLE XII. Percentage Distribution of Merged Officer Master File Explanatory Binary Variables By Accession Category (Continued)

	DATA AS OF END 1987			DATA AS OF END 1993		
VARIABLE	DP (53.6)	IPP (35.7)	POOLED DATA	DP (57.7%)	IPP (32.9%)	POOLED DATA
PERSONAL DEMOGRAPHICS						
WHITE	85.9	92.0	89.3	84.7	89.0	86.9
BLACK	6.7	4.2	5.3	9.4	5.4	7.5
OTHER RACE	7.4	3.8	5.6	5.9	5.6	5.6
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
USN	46.8	100.0	70.4	58.5	100.0	75.1
USNR	53.2	0.0	29.6	41.5	0.0	24.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
NINE OR MORE YEARS PRIOR ENLISTED SVC	24.2	79.2	34.1	23.8	77.8	30.6
4 TO 8 YEARS PRIOR ENLISTED SVC.	31.8	20.8	27.3	30.1	22.2	26.3
FOUR OR LESS YEARS PRIOR ENLISTED SVC	44.0	0.0	30.5	46.1	0.0	33.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
SINGLE	25.8	3.4	16.0	18.1	5.0	13.0
SINGLE WITH DEPENDENTS	3.6	4.2	4.1	3.9	5.1	4.3
MARRIED WITH MILITARY SPOUSE	10.1	8.4	9.9	11.5	7.6	10.2
MARRIED WITH DEPENDENTS	60.5	84.0	70.0	66.5	82.3	72.5
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File.

TABLE XIII. Means and Standard Deviations of Officer Master File Explanatory Continuous Variables By Accession Category

	DATA AS OF END 1987			DATA AS OF END 1993		
VARIABLE	DP (53.6)	IPP (35.7)	POOLED DATA	DP (57.7%)	IPP (32.9%)	POOLED DATA
AGECOM	28.1	30.1	28.6	28.5	30.3	28.8
YEARS OF COMMISSIONED SERVICE	5.1	8.5	6.9	8.0	12.7	10.3
YEARS PRIOR ENLISTED TIME	5.0	10.7	6.8	4.5	10.4	6.2
COLLEGE QUALITY	3.1	3.3	3.2	2.9	3.1	3.0
PRCTEP	0.38	0.48	0.43	0.58	0.62	0.59
PRCTEP3	0.08	0.09	0.08	0.14	0.05	0.10
PRCTEP10	0.35	0.31	0.31	0.43	0.31	0.37

Source: Derived from data obtained from the Defense Manpower Data Center and the Navy Personnel Research and Development Center.

2. Multivariate Analysis

The trends in the data identified in the bivariate analysis present differences in the composition of the two procurement categories (IPP and DP). Using the variables with notable differences, multivariate models are designed to further assess the varying factors that influence performance. College quality indicators, level of education, personal demographics, and procurement source are predominant in the multivariate models to measure their influence on performance, holding everything else constant. As discussed in Chapter III, the analysis uses OLS models to estimate fitness report performance and logit models to estimate the change in probabilities for selection for promotion and for having fitness report ratios above the mean values.

Data from the three fitness report models are combined within one table to ease comparison of the different points of an officer's career. The variable, recommendations for early promotion (PRCTEP), contains a ratio of all fitness reports for each officer and

is not restricted by pay grade or years of commissioned service. To account for the disparity in the number of fitness reports received by a captain and the number received by an ensign, these data were standardized prior to analysis. The mean number of fitness reports was set at 50 with a standard deviation of 10. Using these mean and standard deviation values, instead of one and zero values, respectively, eliminated negative ratios while standardizing the data. This is the same procedure used by Neuman and her associates in 1989.

Table XIV displays the results of the OLS regression models. Although the models are statistically significant, the R-squares provide an indicator of their limited predictive abilities. Attempts to correct and identify selectivity bias in these models only marginally changed the results. *A' priori* knowledge leads to the assumption that most of the influence on performance is due to intangible, or unavailable, variables, such as personal motivation and previous work experience. IPP was the only statistically significant variable at the 95 percent confidence level. The coefficient estimate indicates that procurement through the IPP reduces PRCTEP3 by 8.7 percent. Two variables were statistically significant within the PRCTEP10 model. Years of enlisted service increases PRCTEP10 by 0.05 percent for each additional year of prior enlisted service and having a college major in administration or management (QUALMAJ) increases PRCTEP10 by 5 percent. These results are consistent in the PRCTEP model. WHITE reduces the PRCTEP ratio by 5 percent.

TABLE XIV. Ordinary Least Squares Model Estimating the Effect of Accession Source on HCA Fitness Report Performance Ratios of Recommendations for Early Promotion

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES PRCTEP3	COEFFICIENT ESTIMATES PRCTEP10	COEFFICIENT ESTIMATES PRCTEP
DIRECT PROCUREMENT	- 0.045 (0.026)	- 0.049 (0.029)	- 0.033 (0.085)
INSERVICE PROCUREMENT	- 0.087 (0.030) *	0.004 (0.033)	- 0.044 (0.030)
B. S. DEGREE	0.037 (0.037)	0.023 (0.041)	0.018 (0.038)
M. S. DEGREE	- 0.006 (0.004)	0.037 (0.040)	- 0.011 (0.037)
HIGH COLLEGE QUALITY	0.014 (0.019)	0.004 (0.021)	- 0.004 (0.019)
MEDIUM COLLEGE QUALITY	- 0.015 (0.018)	- 0.036 (0.019)	0.020 (0.018)
YEARS OF ENLISTED SERVICE	0.0004(0.003)	0.005 (0.003) *	0.010 (0.003) *
AGE WHEN COMMISSIONED	- 0.002 (0.002)	- 0.002 (0.003)	0.007 (0.002)
COLLEGE MAJOR IN MANAGEMENT OR ADMINISTRATION	0.023 (0.014)	0.052 (0.026) *	- 0.040 (0.024) *
WHITE	0.037 (0.021)	0.022 (0.023)	- 0.054 (0.021) *
F-value	27.036	77.9	4.35
R-square	0.18	0.50	0.046
Durbin-Watson	2.012	2.002	1.921

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File and the Navy Personnel Research and Development Center Fitness Report File as of the end of fiscal 1993.

Table XV displays the logit estimate results of the model for having a PRCTEP greater than the mean value of 0.59 (GREAT). There are five statistically significant explanatory variables within this model. Predictive ability for this model is much stronger than the OLS performance models. Using the concordant ratio as indicator, this model explains over 59 percent of the variation of being above or below the mean PRCTEP.

Having a college degree in management or administration increases the probability of being GREAT by 11 percent. WHITE increases the probability by 9 percent. Being married with children increases the probability by 2 percent. Years of prior enlisted service increases the probability of being GREAT by 1.5 percent for every additional year of prior enlisted service. Age at time of commissioning decreases the

probability of being evaluated as GREAT by 1.7 percent for every additional year of age, offsetting the increased effect of prior enlisted service by 0.2 percent for each year.

TABLE XV. Logit Model Estimating the Probability of Performing Above Mean Values for Fitness Report Ratios of Recommendations for Early Promotion

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES	CHANGE IN PROBABILITY
DIRECT PROCUREMENT	- 0.03 (0.27)	- 0.008
INSERVICE PROCUREMENT	- 0.07 (0.30)	- 0.180
HIGH COLLEGE QUALITY	- 0.11 (0.18)	- 0.028
MEDIUM COLLEGE QUALITY	0.23 (0.15)	0.470
M. S. DEGREE	- 0.31 (0.33)	- 0.076
B. S. DEGREE	-0.13 (0.33)	- 0.032
COLLEGE MAJOR IN MANAGEMENT OR ADMINISTRATION	0.45 (0.21) *	0.110
MALE	- 0.11 (0.18)	- 0.027
WHITE	0.37 (0.18) *	0.091
MARRIED WITH DEPENDENTS	0.73 (0.15) *	0.021
YEARS OF ENLISTED SERVICE	0.04 (0.02) *	0.015
AGE WHEN COMMISSIONED	- 0.11 (0.02) *	- 0.027
Chi-Square 40.13		
Concordant ratio 59.5		

* Statistically significant at the 95 percent confidence level

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File and the Navy Personnel Research and Development Center Fitness Report File as of the end of fiscal 1993.

The selection for promotion model (Table XVI) is a statistically more predictive model that provides an indicator of performance. The concordant ratio is relatively high and indicates that almost 76 percent of the variation of being selected for or being passed over for promotion may be explained by the model. Six explanatory variables are statistically significant in affecting the promotion selection decision.

Having a bachelor's degree, as opposed to the base case of having no degree, increases the probability of being selected for promotion by 37 percent. Being male decreases the probability by 30 percent. Being married with children increases the probability by 18 percent. Age at time of commissioning decreases the probability by 2 percent for each additional year of age. DP increases the probability of being selected for promotion by 19 percent.

Two additional models using the same variables were designed to estimate the changes in probability of promotion to pay grades lieutenant commander and then combining commander and captain. The results were not significantly different, with the exception that direct procurement was no longer statistically significant and the changes in probability as a result of age were more pronounced. Also years of enlisted service was positively significant for promotion to commander and captain. However, the negative influence of age at time of commissioning off-set the positive influence of prior enlisted service by 17 percent for each additional year of age. Intuitively, this off-setting change is apparent as each added year of enlisted service also increases age by one year. Also, the positive influence of years of enlisted service may be due to the past policy of obtaining MSC HCAs primarily from enlisted personnel. Results of these two additional FOS models may be found in Appendix B.

TABLE XVI. Logit Model Estimating the Probability of Being Selected for Promotion for HCAs Reviewed for Promotion Between 1987 and 1993

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES	CHANGE IN PROBABILITY
DIRECT PROCUREMENT	0.83 (0.39) *	0.199
INSERVICE PROCUREMENT	0.43 (0.49)	0.102
HIGH COLLEGE QUALITY	- 0.64 (0.32)	- 0.153
MEDIUM COLLEGE QUALITY	- 0.23 (0.30)	- 0.005
M. S. DEGREE	0.97 (0.60)	0.233
B. S. DEGREE	1.56 (0.61) *	0.374
COLLEGE MAJOR IN MANAGEMENT OR ADMINISTRATION	0.24 (0.38)	0.057
MALE	- 1.26 (0.40) *	- 0.301
WHITE	- 0.21 (0.40)	- 0.049
MARRIED WITH DEPENDENTS	0.74 (0.31) *	0.176
YEARS OF ENLISTED SERVICE	0.04 (0.04)	0.009
AGE WHEN COMMISSIONED	- 0.11 (0.05) *	- 0.026
Chi-Square 35.51		
Concordant ratio 75.9		

* Statistically significant at the 95 percent confidence level

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File and the Navy Personnel Research and Development Center Fitness Report File as of the end of fiscal 1993.

V. CONCLUSIONS AND RECOMMENDATIONS

While answering the primary research questions, this study identified additional questions that should be answered to complete the analysis. Trends and differences between the DP and IPP accession programs have been explained. Multivariate analysis has detected statistically significant variables that influence retention and performance. However, this information is only a part of the research required to draw definitive conclusions about the effectiveness of MSC HCA accession programs.

The 1987 policy changes requiring IPP officers IPP to have a minimum of a bachelor's degree, combined with increased emphasis on accessing master's degree DP applicants to the MSC have increased the educational level of officers in the HCA community. Officers accessed through DP have higher education levels than those obtained through IPP, but more than 60 percent of the total HCAs exceed the minimum educational requirement for commissioning. Further changes to the program authorization requiring administrative or management degrees resulted in officers who are academically prepared to assume the duties and responsibilities of health care executives. The positive statistically significant effect of having a degree in management or administration on performance and promotion (as depicted in the multivariate models) supports the standards established in the current program authorization for the MSC HCA community.

The MSC HCA community has emerged as a diverse and well-educated group of professionals who generally decide to remain on active duty until they become retirement eligible. In the case of officers accessed through the IPP, this decision tends to occur within a few years of completing ten years as a commissioned officer. As a result, IPP officers generally retire with fewer years of commissioned service than officers accessed through DP. The most prevalent variables affecting separation behavior and performance are age at time of commissioning and years of prior enlisted service. Within the multivariate models, accession source is not consistently significant, whereas age and years of prior enlisted service are frequently significant. Age at time of commissioning

years of prior enlisted service are frequently significant. Age at time of commissioning was negatively correlated with fitness report ratings, years of commissioned service, and probability of being selected for promotion. The negative influence of age at time of commissioning was consistently greater than the positive influence of years of enlisted service.

Although both the IPP and DP provide officers that remain for a full twenty year career, results indicate that once DP officers decide to stay beyond their initial service obligation they tend to stay longer than IPP officers. The significance of the variable measuring regular Navy status suggests that obtaining "tenure" as a regular Navy officer is pivotal in the decision process of weighing benefits and costs of staying or leaving. It is difficult to measure the effect of the relatively limited ability for DP accessions to obtain regular Navy status on the earlier separation behavior of these officers. Changing the policy of granting automatic regular Navy commissions to IPP accessions might increase the DP officer's opportunity to become a regular Navy officer and may alter the individual's early separation behavior.

Despite increased reliance on the DP accession path, which began in the 1980s (see table 1.5, Appendix A), the MSC HCA community continues to be staffed predominately with officers who have prior enlisted service. Over 61 percent of the HCAs on active duty at the end of fiscal 1993 had between four and seventeen years of prior experience in the enlisted ranks. An additional 14.4 percent of the officers accessed through DP had one to four years as an enlisted member (total DP prior enlisted is 59.4 percent). These findings suggest that the positive influence as role models of MSC HCAs in the mentoring of enlisted personnel serves to draw enlisted personnel into the MSC HCA community. Combining an effective sensa-mentor relationship with encouragement, as well as the means to pursue a college education, allows the MSC HCAs to select and "grow their own" officers who are dedicated to providing quality health care to eligible beneficiaries. Since Navy Medicine is deeply committed to facilitating continued education, through accredited programs, motivated enlisted

Given these factors and the evidence of the relatively high proportion of DP officers who have prior enlisted experience (over 59 percent of officers accessed through the DP have prior enlisted service), this source appears to be an effective path for enlisted personnel to obtain a commission.

Bivariate analysis indicates that the officers accessed through the DP generally receive higher fitness report scores than their IPP counterparts early in their career as a commissioned officer. Multivariate analysis indicates that years of prior enlisted service is not statistically significant when estimating fitness report performance during the first three years of commissioned service and is not practically significant after ten years of commissioned service. In addition, MSC HCAs with less than four years of service have fitness report scores above the mean values, higher education levels and college quality ratings than officers with substantial enlisted service (see Table A.1 in Appendix A). These findings seem to diminish the value of having substantial prior enlisted experience with respect to effectiveness as an MSC HCA.

This study has only begun to lay the ground work needed for further analytical studies and raises many more questions. First, if only 30 percent of HCAs stay to complete twenty years of commissioned service, does their loss at the normal flow points for promotion hinder or help planning efforts to provide a well-balanced officer community, with credible opportunities for promotion?

Data indicate that "problems" surrounding the performance differences of officers accessed through the two accession paths are more an issue of age at time of commissioning and not the quality of the officer selected through the IPP. Does this suggest that a change is needed to reduce the age for accession into the MSC?

Reviewing the data might lead one to conclude that the IPP be remodeled to more closely resemble the "Seaman-to-Admiral" program. The "Seaman-to-Admiral" program is open to all petty officers second class and above who have completed four years of enlisted service. Applicants must be able to be commissioned prior to their 27th birthday. After selection and indoctrination, this program requires that the officer enter a specific

warfare community pipeline. After successfully completing an initial sea tour, officers are sent to fully-funded education programs to complete their bachelor's degree. This allows for a wide pool of relatively young applicants that are "sea-tested" before the Navy proceeds with additional investments in human capital.

The MSC is steadily becoming staffed with better educated officers and is actively pursuing methods to monitor the professional development needed to meet the demands of the dynamic changes in the health care environment. The change in June 1993 to decrease the IPP minimum pay grade requirement from E-6 to E-5 may alter the picture of the "average" MSC HCA accessed through the IPP. Increasing the pool of applicants in this manner may allow for younger and better educated applicants with less time as an enlisted member of the health care delivery team. These recent pay grade changes (and not awarding regular Navy status to newly-commissioned MSC HCAs) may eventually affect the separation behavior and performance of the officers.

Before recommendations for policy changes are made, several other aspects involving individual performance, the added value of each program, and cost-effectiveness should be explored. While this research suggests that officers accessed through the DP have higher levels of education and generally perform better than IPP officers early in their career, further research is needed before definitive explanations for these differences can be ascertained. Differences in separation behavior, performance, promotion, and the education levels between officers obtained through the IPP and DP suggest that further study of MSC HCA accession policies be undertaken. Obtaining the right force mixture is needed to ensure that MSC HCA community has the base to provide senior leadership in the future.

First, a complete benefit-cost analysis should be completed to identify the optimum accession source mix. In terms of human capital investment, cost analysis is not based solely on average costs of education, training, and transportation. All costs (starting with filling out an application for accession and closing with the end of the officer's relationship with the military) associated with each of the accession sources should be

well as opportunity costs to the Navy of choosing different accession sources must be estimated and included in the analysis. Without accounting for every possible cost, it is difficult to establish the cost to the organization and the individual. Although this information is difficult to obtain and measure, sound policy decisions usually require review of this piece of the analytical puzzle.

Second, a longitudinal cohort study, with merged active duty and loss files, should be conducted to track performance, retention, and promotion patterns within a like year group. Since the MSC has relatively small year groups, two year groups could be combined. Combining two year groups would provide a cross-sectional, quasi-longitudinal group that would be statistically sound and eliminate some of the bias inherent with cohort data. Cohort studies would provide a glimpse into the performance and retention patterns of MSC HCAs when compared with their peers who were selected for commission by the same selection boards. Subsequent research should use the data being developed to evaluate attainment of professional qualifications through the American College of Health Care Executives (ACHE) and prior work experience for a comprehensive comparison of the two accession groups of officer accessions through the DP and IPP. Additional data used in models of officer effectiveness may better quantify the performance of officers based on commissioning source and associated human capital investments.

Finally, models predicting the probability of successfully screening for Commanding Officer or Executive Officer, based on executive competencies currently under development would assist in understanding the possible factors that influence an MSC HCA's ability to serve in an executive medicine position. This analysis would assist in determining if either, or both, of these accession programs provide career-motivated health care executives.

APPENDIX A. FREQUENCY TABLES

TABLE A.1. Percentage Frequencies, Means, and Standard Deviations of MSC HCAs With Less Than Four Years Prior of Enlisted Service and on Active Duty at the End of Fiscal 1993 (N=404)

VARIABLE	MEAN/STANDARD DEVIATION	PERCENTAGE FREQUENCY
PRCTEP	0.56 (0.24)	--------
PRCTEP3	0.10 (0.24)	--------
PRCTEP10	0.31 (0.34)	--------
COLLEGE QUALITY	3.26 (1.21)	--------
AGECOM	26.4 (3.4)	--------
YEARS PRIOR ENLISTED SERVICE	0.31 (0.80)	--------
M.S. DEGREE	---------	72.3
B. S.DEGREE	---------	26.4
PHD	---------	1.3
HIGH COLLEGE QUALITY	---------	33.2
MEDIUM COLLEGE QUALITY	---------	42.6
LOW COLLEGE QUALITY	---------	24.2
MALE	---------	89.9
FEMALE	---------	11.1
WHITE	---------	89.9
BLACK	---------	6.0
OTHER RACE	---------	4.7

Note Standard deviations are in parenthesis.

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File and the Navy Personnel Research and Development Center Fitness Report File as of the end of fiscal 1993.

TABLE A.2. Means and Standard Deviations of HCAs With Fitness Report Ratios Recommending Early Promotion Above Mean Values for MSC HCAs on Active Duty as of the End of Fiscal 1993

VARIABLE	ALL FITREPS (GREAT)	FITREPS FIRST 4 YEARS COMSVC (GREAT3)	FITREPS FIRST 10 YEARS COMSVC (GREAT10)
DP	0.554 (0.48)	0.821 (0.38)	0.682 (0.47)
IPP	0.352 (0.49)	0.142 (0.35)	0.284 (0.45)
4 OR LESS YEARS PRIOR ENLISTED SERVICE	0.307 (0.46)	0.327 (0.47)	0.307 (0.46)
4 TO 8 YEARS PRIOR ENLISTED SERVICE	0.267 (0.44)	0.261 (0.44)	0.254 (0.43)
9 OR MORE YEARS PRIOR ENLISTED SERVICE	0.324 (0.47)	0.315 ((0.47)	0.333 (0.47)
MALE	0.815 (0.38)	0.684 (0.46)	0.743 (0.43)
MARRIED WITH CHILDREN	0.752 (0.43)	0.619 (0.49)	0.678 (0.47)
AGE WHEN COMMISSIONED	28.8 (3.4)	29.1 (3.6)	29.4 (3.5)
NO DEGREE	0.390 (0.19)	0.012 (0.11)	0.033 (0.18)
B.S. DEGREE	0.387 (0.49)	0.595 (0.39)	0.499 (0.50)
M.S. DEGREE	0.566 (0.49)	0.392 (0.49)	0.464 (0.50)
HIGH COLLEGE QUALITY	0.327 (0.47)	0.250 (0.43)	0.286 (0.45)
MEDIUM COLLEGE QUALITY	0.366 (0.48)	0.466 (0.50)	0.410 (0.492)
LOW COLLEGE QUALITY	0.301 (0.46)	0.285 (0.45)	0.303 (0.460)
MANAGEMENT OR ADMIN COLLEGE MAJOR	0.906 (0.29)	0.946 (0.23)	0.917 (0.282)

Note: Standard deviations are in parenthesis.

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File and the Navy Personnel Research and Development Center Fitness Report File as of the end of fiscal 1993.

TABLE A.3. Mean Values of Fitness Report Recommendations for Early Promotion Ratios for MSC HCAs on Active Duty as of the End of Fiscal 1993, By Pay Grade and Accession Source

PAY GRADE	IPP	DP	ALL HCAs
ENSIGN	0.602	0.588	0.601
LTJG	0.606	0.583	0.589
LT	0.610	0.583	0.579
LCDR	0.585	0.561	0.577
CDR	0.588	0.572	0.594
CAPT	0.655	0.556	0.653

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File and the Navy Personnel Research and Development Center Fitness Report File as of the end of fiscal 1993.

TABLE A.4. Mean Values for Time in Grade for MSC HCAs on Active Duty as of the End of Fiscal 1993, By Pay Grade and Accession Source

PAY GRADE	IPP (N=392)	DP (N=687)
ENSIGN	1.0 (0.6)	1.9 (0.8)
LTJG	0.9 (0.6)	1.2 (0.6)
LT	3.4 (1.9)	2.8 (2.2)
LCDR	2.2 (2.7)	2.5 (2.2)
CDR	3.4 (2.6)	2.2 (2.1)
CAPT	2.9 (2.8)	2.8 (2.2)

Note: Standard deviations are in parenthesis.
Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File as of the end of fiscal 1993.

TABLE A.5. Distribution of Sample (Number) of MSC HCAs on Active Duty at the End of Fiscal 1993, By Year Group and Accession Source,

YEAR GROUP	IPP	DP	TOTAL HCAs
1964-65	5	0	7
1966-67	12	3	17
1968-69	9	3	19
1970-71	13	6	25
1972-73	53	20	82
1974-75	12	9	59
1976-77	28	25	76
1978-79	14	50	70
1980-81	29	61	101
1982-83	66	96	167
1984-85	51	69	126
1986-87	46	115	166
1988-89	29	133	168
1990-93	25	97	123
TOTAL	392	687	1206

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File as of the end of fiscal 1993.

TABLE A.6. Percentage Distribution of HCAs for MSC HCAs on Active Duty at the End of Fiscal 1993, By Sub-specialty and Accession Source

SPECIALTY	IPP (N=392)	DP (N=687)
FINANCIAL MANAGEMENT	9.7	12.5
MATERIAL LOGISTICS SUPPORT	4.1	1.6
MANPOWER, PERSONNEL, AND TRAINING ANALYSIS	3.3	2.6
EDUCATION AND TRAINING	1.5	1.0
OPERATIONS RESEARCH	0.3	.06
COMPUTER TECHNOLOGY	0.0	2.1
PROFESSIONAL HEALTH CARE ADMINISTRATOR	52.3	48.2
PATIENT AFFAIRS	7.4	13.5
MEDICAL SUPPLY/LOGISTICS	6.1	6.1
MEDICAL DATA SERVICES	1.3	2.5
MEDICAL CONSTRUCTION LIAISON OFFICER	2.3	1.7
ADMINISTRATIVE DIETETICS	0.0	1.5
PLANS, OPERATIONS, AND MEDICAL INTELLIGENCE	11.7	6.1
TOTAL	100.0	100.0

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File as of the end of fiscal 1993.

TABLE A.7. Percentage Distribution for MSC HCAs on Active Duty at the End of Fiscal 1993, By Sub-specialty Utilization and Accession Source

UTILIZATION ASSIGNMENT	DP (N=392)	IPP (N=687)
OPERATIONAL TOUR TO MAINTAIN WARFARE SPECIALTY	14.0	10.9
EDUCATIONAL ASSIGNMENT	2.6	6.0
GRADUATE EDUCATION MEETS BILLET REQUIREMENT	7.4	11.3
GRADUATE EDUCATION CLOSELY RELATED TO BILLET REQUIREMENT	5.4	5.8
BILLET USES SPECIALTY IN BILLET NOT REQUIRING ADVANCED EDUCATION	13.1	26.2
ASSIGNMENT USING SPECIALTY IN UNCODED BILLET	4.6	7.0
OFFICER HAS MORE THAN ONE SPECIALTY CODE	1.8	1.0
NON-UTILIZATION OF SPECIALTY	0.8	0.4
OFFICER WITHOUT GRADUATE EDUCATION FILLING BILLET	50.3	31.4
TOTAL	100.0	100.0

Note: Degrees obtained through off-duty education and fully-funded education.

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File as of the end of fiscal 1993.

TABLE A.8. Percentage Distribution of HCAs on Active Duty at the End of Fiscal 1993, By Education Major and Accession Source

SPECIALTY	IPP (N=392)	DP (N=687)
MANAGEMENT	7.1	4.4
HEALTH CARE	9.7	6.5
PUBLIC HEALTH	1.5	2.4
PUBLIC ADMINISTRATION	3.1	5.1
BUSINESS ADMINISTRATION	58.9	72.4
EDUCATION	2.6	1.0
OTHER	17.1	8.2
TOTAL	100.0	100.0

Note: Degrees obtained through off-duty education or fully funded graduate education.
Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File as of the end of fiscal 1993.

TABLE A.9. Frequency Distribution of College Degrees Completed After Commissioning for MSC HCAs on Active Duty at the End of Fiscal 1993, By Accession Source

DEGREE LEVEL AND QUALITY	DP	IPP
B. S. DEGREE	22.7	46.0
M. S. DEGREE	73.3	42.0
PHD	0.5	0.0
HIGH COLLEGE QUALITY	35.9	40.0
MEDIUM COLLEGE QUALITY	32.3	32.7
LOW COLLEGE QUALITY	31.8	27.3

Note: Percentages for degree level do not add to 100% due to other categories of degrees or certificates earned.
Degrees obtained through off-duty education or fully funded graduate education.

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File as of the end of fiscal 1993.

APPENDIX B. MULTIVARIATE REGRESSION MODEL RESULTS

TABLE B.1. Proportional Hazard Model Results Estimating the Effect of Prior Enlisted Service on Retirement for MSC HCAs Who Separated from the Navy Between Fiscal 1987 and 1993

INDEPENDENT VARIABLES	CARENL COEFFICIENT ESTIMATES	NON-CARENL COEFFICIENT ESTIMATES
REGULAR NAVY STATUS	0.95 (0.39) *	1.21 (0.54)*
YEARS OF EDUCATION	0.006 (0.05)	0.07 (0.07)
MALE	1.64 (0.62) *	0.17 (0.63)
MARRIED WITHOUT CHILDREN	- 0.05 (0.28)	0.025 (0.48)
MARRIED WITH CHILDREN	0.29 (0.06) *	- 0.15 (0.08)
WHITE	0.33 (0.32)	0.20 (0.60)
AGE WHEN COMMISSIONED	- 0.15 (0.05) *	- 0.15 (0.48) *
YEARS OF ENLISTED SERVICE	0.05 (0.05)	0.03 (0.04)
Chi-Square	68.36	24.25
-2 Log Likelihood	1549.40	906..0

* Statistically significant at the 95 percent confidence level

Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993

TABLE B.2. Proportional Hazard Model Results Estimating the Effect of Prior Enlisted Service on Voluntary Releases from Active Duty for MSC HCAs Who Separated from the Navy Between Fiscal 1987 and 1993

INDEPENDENT VARIABLES	CARENL COEFFICIENT ESTIMATES	NON-CARENL COEFFICIENT ESTIMATES
REGULAR NAVY STATUS	----------	10.48 (21.5)
YEARS OF EDUCATION	0.10 (0.11)	0.11 (0.15)
MALE	----------	- 0.55 (0.30) *
MARRIED WITH CHILDREN	- 0.34 (0.08) *	0.025 (0.48)
MARRIED WITHOUT CHILDREN	1.17 (0.08)	- 0.90 (0.08)
WHITE	0.66 (0.29) *	0.60 (0.31) *
AGE WHEN COMMISSIONED	- 0.06 (0.03)	- 0.02 (0.04)
YEARS OF ENLISTED SERVICE	0.32 (0.06) *	0.17 (0.08) *
Chi-Square	99.74	145.95
-2 Log Likelihood	897.42	741.64

* Statistically significant at the 95 percent confidence level

Note: Unable to compute regular Navy status and male--all CARENL were male and USN.
Source: Derived from data obtained from the Defense Manpower Data Center Officer Loss File as of the end of fiscal 1993.

TABLE B.3. Logit Model Estimated Probability of Being Selected for Promotion to Lieutenant Commander for MSC HCAs

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES	CHANGE IN PROBABILITY
DIRECT PROCUREMENT	0.74 (1.12)	0.154
INSERVICE PROCUREMENT	0.27 (1.19)	0.056
HIGH COLLEGE QUALITY	- 0.93 (0.51)	- 0.019
MEDIUM COLLEGE QUALITY	0.12 (0.47)	0.025
M. S. DEGREE	0.93 (0.86)	0.194
B. S. DEGREE	2.13 (0.84) *	0.445
COLLEGE MAJOR IN MANAGEMENT OR ADMINISTRATION	- 0.19 (0.63)	- 0.039
MALE	- 1.09 (0.56) *	- 0.228
WHITE	0.06 (0.47)	0.013
MARRIED WITH DEPENDENTS	0.74 (0.45)	0.155
YEARS OF ENLISTED SERVICE	- 0.02 (0.05)	- 0.004
AGE WHEN COMMISSIONED	- 0.13 (0.07) *	- 0.027
Chi-Square 35.51		
Concordant ratio 75.9		

* Statistically significant at the 95 percent confidence level

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File as of the end of fiscal 1993.

TABLE B.4. Logit Model Estimated Probability of Being Selected for Promotion to Commander or Captain for MSC HCAs

INDEPENDENT VARIABLES	COEFFICIENT ESTIMATES	CHANGE IN PROBABILITY
DIRECT PROCUREMENT	0.35 (0.49)	0.087
INSERVICE PROCUREMENT	- 0.007 (0.68)	- 0.002
HIGH COLLEGE QUALITY	- 0.88 (0.46)	- 0.315
MEDIUM COLLEGE QUALITY	- 0.39 (0.45)	- 0.097
M. S. DEGREE	1.35 (0.99)	0.335
B. S. DEGREE	0.44 (1.07)	0.109
COLLEGE MAJOR IN MANAGEMENT OR ADMINISTRATION	0.37 (0.56) *	0.092
MALE	- 1.16 (0.97)	- 0.288
WHITE	- 0.69 (0.40)	- 0.171
MARRIED WITH DEPENDENTS	1.22 (0.52) *	0.302
YEARS OF ENLISTED SERVICE	0.16 (0.07) *	0.039
AGE WHEN COMMISSIONED	- 0.24 (0.08) *	- 0.060
Chi-Square 23.88		
Concordant ratio 71.0		

* Statistically significant at the 95 percent confidence level

Source: Derived from data obtained from the Defense Manpower Data Center Officer Master File as of the end of fiscal 1993.

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5.	Bureau of Medicine and Surgery Office of the Director, Medical Service Corps Code MED-00MSC Washington, D. C. 20372	3
6.	Bureau of Medicine and Surgery Attn: Captain William Knox, MSC, USN Code MED-15 Washington, D. C. 20372	1
7.	Bureau of Naval Personnel Attn: Lieutenant Commander Shayne Brannman, MSC, USN Code PERS-211 Washington, D. C. 20370	1